MYCOLOGIA

OFFICIAL ORGAN OF THE MYCOLOGICAL SOCIETY OF AMERICA

VOL. XXVIII NOV.–DEC., 1936 NO. 6

A NEW SPECIES OF ARACHNIOTUS

J. W. HOTSON

(WITH 13 FIGURES)

The genus *Arachniotus* was created by Schröter in 1893 for the reception of *A. candidus* (Eidam) Schröt. (**1**, **2a**, **3**), and *A. aureus* (Eidam) Schröt. (**2a**, **3**), previously referred to the genus *Gymnoascus*. In these species the ascospores are hyaline, yellowish, or red; the fruit-body globose or sub-globose, and the peridium composed of loosely interwoven hyphae of more or less uniform size and without any special appendages. On these characteristics the new genus, *Arachniotus*, was based. The first species, considered the type, was found growing on well-rotted manure in Germany, and in 1901 on an old nest of wild bees, and on dung of the common Roe at Kew, England (**1**); the fruit-bodies .5–2 mm. in diameter, hyaline; asci ovate; ascospores 3–3.5 μ, hyaline and smooth. The second species was found on decaying vegetables, on wet paper, and on bread in Silesia; the fruit-bodies globose, 1.5–1 mm. in diameter, yellow, hyphae somewhat spiral; asci 8-spored; ascospores 3.5–4 μ, yellowish, and minutely spiny. Later *A. ruber* (Van Teigh.) Schröt. (**2b**, **4**) was transferred to this genus. It is a coprophilous form reported from France, Germany, and Britain in Europe and from the Gold Coast in Africa. The distinguishing character of this species is the color of the fruit-body which is pale-yellow at first, but soon turning orange,

[MYCOLOGIA for September–October (**28**: 399–496) was issued October 1, 1936]

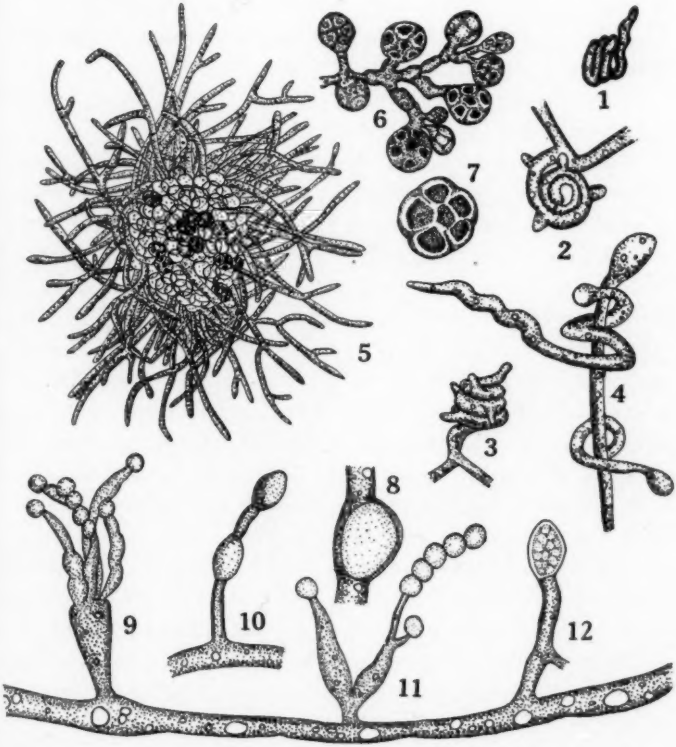
and finally becoming dark reddish-orange. In 1902, two other species were added to the genus. The first of these, *A. citrinus* Mass. & Salm. (**1, 2b**), was found on the dung of the giant Kangaroo at Kew in England, the fruit-bodies sub-globose, .5–1 mm. in diameter, hyaline at first, becoming bright lemon-yellow, the spores also yellowish; and the second, *A. trachyspermus* Shear (**2b, 5, 6**) found associated with diseased cranberries grown in New Jersey, is the only species reported for North America. The lemon-yellow, echinulate ascospores, the size of the fruit-body (325–425 μ), and the absence of chlamydospores are the most marked differences between the last species and the one under consideration.

Besides *Arachniotus* there are four other closely related genera belonging to the Gymnoascaceae. Of these *Amaurascus* is distinguished by its brown or brownish-violet ascospores, while the other three genera differ in the character of the peridium of the fruit-body. All three of these have peridia with interwoven hyphae, armed with spines or prongs in *Gymnoascus;* with circinate appendages at the tip in *Myxotrichum;* and appendages comb-like in *Ctenomyces.*

In 1914 another species of *Arachniotus* was isolated from contaminated milk sent to the Botany Department of the University of Washington. This organism proved to be an interesting one and has been used for over twenty years as one of the types studied in the classes in mycology. It grows readily on almost any medium and the different stages in the development of the ascocarp are relatively easy to follow. The medium commonly used was Thaxter's potato-agar. Cultures less than a week old produce conidia. About the same time or a few days later, on the same mycelium, chlamydospores are developed and in two to three weeks the ascocarps with asci and ascospores appear.

The *mycelium,* as it appears in cultures, is procumbent and almost pure-white, becoming slightly yellowish with age. The diameter varies from 2.7–4.5 μ. Not infrequently, however, swollen cells (8–11 μ) are developed which seem to be food-storage organs. The *conidia* are hyaline, one-celled, slightly elliptical, 3.5–4.5 $\times$ 4.5–5.5 μ. They are produced in chains on bottle-shaped sterigmata which are formed on short lateral branches, scattered

over the hyphae or sometimes several on an erect conidiophore approaching in appearance species of *Penicillium* (FIG. 9). The *chlamydospores* vary somewhat in form but are usually more or



FIGS. 1–12. *Arachniotus trisporus*. 1–4, stages in the development of the primordium; 5, the ascocarp showing asci in the center and the loosely interwoven hyphae forming the peridium; 6, an ascogenous branch showing asci and ascospores; 7, a mature ascus; 8, a food storage cell; 10 and 12, chlamydospores; 9 and 11, conidia.

less pear-shaped, 6–7 × 7–11 μ, formed singly at the ends of short branches. Rarely are they intercalary. These spores have thick walls, a characteristic which makes it possible for the fungus to be tided over fairly long periods of adverse conditions.

In cultures about two or three weeks old, primordia of the ascocarp may be found. These consist of a spiral ascogonium closely surrounding a central branch, the *antheridium* (FIG. 1–4). This central body is not always present—in some instances the coil was formed but no evidence of the central cell was observed. From the cells composing the spiral, branches are produced. These may divide and subdivide, the ends of the ultimate branches forming the asci, in a manner similar to those reported for allied genera of the Gymnoascaceae.

The mature ascocarp is sessile, more or less globose or slightly flattened, 160–326 μ in diameter. At times several of these are formed close together and often merge into each other, forming a sort of compound fruit-body. The peridium is composed of loosely interwoven, undifferentiated hyphae. In the center of the ascocarp numerous asci are produced forming a compact mass. These are elliptical to nearly globose, 7–9 $\times$ 10–11 μ in diameter, and eight spored. The wall of the ascus soon becomes gelatinized and disappears, but the eight spores are held intact for a considerable time. The ascospores are thin-walled, hyaline, smooth, elliptical, measuring 3.5 $\times$ 5.5 μ. After they become separated from the ascus they resemble very closely the conidia in size and color and might easily be mistaken for them.

This species is distinguished by the white mycelium, the smooth ascospores, the small size of the fruit-body, and the presence of three kinds of spores in its life cycle. It is thus morphologically different from any other species described for this genus, and since it has three distinct spore-forms, the name *Arachniotus trisporus* is proposed.

Arachniotus trisporus sp. nov.

Mycelium hyaline, procumbent, becoming slightly cream-colored with age; *fruit-bodies* sessile, more or less globose, 160–326 μ in diameter, wall composed of undifferentiated cobwebby hyphae which are simple or branched; *asci* elliptical to globose, 7–9 $\times$ 10–11 μ, eight-spored; *ascospores* hyaline, smooth, elliptical, 3.5 $\times$ 5.5 μ; *conidia* hyaline, elliptical, 3.5–4.5 $\times$ 4.5–5.5 μ, on bottle-shaped sterigmata, catenulate; *chlamydospores* subglobose to pyriform, 6–7 $\times$ 7–11 μ, solitary on the ends of short branches.

Obtained from cow's milk in Seattle, Wash., U. S. A.

Mycelio tenui, noveo, effuso; ascomatibus globosis vel sub-globosis 160–326 μ diam., laxis arachnoideis ex hyphis formatis; ascis globosis vel subglobosis, octosporis; sporidiis ellipsoideis, hyalinis, levibus, 3.5 × 5.5 μ diam.; conidiis catenulatis, ellipsoideis, 3.5–4.5 × 4.5–5.5 μ; chlamydosporicis, piriformibus, 6–7 × 7–11 μ.

Habitat in lacte bubulo, Seattle, Amer. bor.

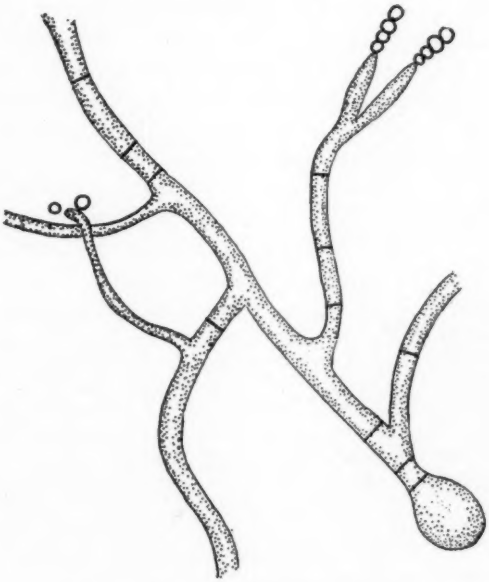


FIG. 13. A germinating chlamydospore.

THE LONGEVITY OF THE FUNGUS

A remarkable characteristic of this species is the length of time it holds its vitality. This was brought to the writer's attention immediately after the World War when he found his cultures which had been neglected for more important work, nearly all dead or over-run with mites. The cultures of *Arachniotus* were completely destroyed by mites. Fortunately there were some old, dried-up tubes that were made in 1917 still available. Cultures from these grew readily. In an effort to determine how long this

fungus would hold its vitality in a dry condition these old cultures which were originally made of potato-agar, were set aside. Eight years later, 1925, transfers were made from these tubes with positive results. The question then arose as to what part of the fungus held the vitality—the mycelium, the conidia, chlamydospores, or ascospores. As was expected, all cultures from the dried-up mycelium failed to grow. Van Teigham cells of the spores were made and the chlamydospores were the only ones that germinated. Every year from 1925 to 1936 similar cultures were made and each year showed only the chlamydospores germinating. The drawing in fig. 13 was made in 1936 from cultures made from the 1917 material. It is planned to test these cultures each year until they lose their vitality.

UNIVERSITY OF WASHINGTON,
SEATTLE

LITERATURE CITED

1. **Massee, G. & Salmon, E. S.** Researches on coprophilous fungi II. Ann. Bot. **16**: 62. 1902.
2. **Saccardo, P. A.** Syll. Fung. (*a*) **11**: 438; (*b*) **18**: 194.
3. **Schröter, J.** In Cohn's Krypt. Fl. Schles. **3²**: 210. 1893.
4. ——. In Cohn's Krypt. Fl. Schles. **3²**: 211. 1893.
5. **Shear, C. L.** *Arachniotus trachyspermus,* a new species of the Gymnoascaceae. Science (n. s.), 16–138. 1902.
6. —— **et al.** Fungous diseases of the cultivated cranberry. Technical Bull. No. 258: 13. 1931. U. S. Dept. Agr.

A NEW SPECIES OF MICROASCUS WITH A SCOPULARIOPSIS STAGE

PHILIP M. JONES

(WITH 24 FIGURES)

INTRODUCTION

During the fall of 1931, Doctor D. C. Smith, Professor of Dermatology and Syphology at the University of Virginia, gave me some dermatophyte cultures growing on Sabauraud's media. He had obtained a fungus in December, 1931, from an infection showing eruptions involving the hands and forearm and it was from the culture of this fungus that I found what I believe to be a new species of *Scopulariopsis*.

On Sabauraud's media the surface growth of this new species was smooth with a whitish growth becoming grayish mealy with the formation of conidia and then turning black with the formation of the ascocarps. The colonies were restricted in extent and became wrinkled and raised above the surface of the agar. One could not consider this a surface growth as a number of the hyphae penetrated one fourth of an inch into the agar. There was very little or no growth on dextrose-tartaric acid media.

In my study of dermatophytes, I have found that those within my experience grow better in Knop's solution in a sterile moist chamber than on agar media. Consequently, the study of all stages of the above fungus except the cross section of the perithecial stage, was made from culture grown on Sabauraud's media. The perithecia develop abundantly, however, in Knop's solution.

Microascus lunasporus sp. nov.

On Sabauraud's medium forming a smooth whitish colony, becoming grayish and mealy as conidia develop, then black with the formation of ascocarps, becoming wrinkled and raised above the surface of agar; mycelium of branched septate hyphae 2–3 μ diameter; no growth on dextrose-tartaric acid media. Conidia produced directly on the mycelium, or on simple or branched conidio-

phores with sterigmata 5–12 μ long; conidia oval to lemon shape, with a collar at the base, 2–4 $\times$ 4–7 μ. Perithecia developing abundantly on Sabauraud's medium and in Knop's solution, 175–300 μ diameter, beaked and with a papillate ostiole, the wall consisting of an outer layer 5 to 8 cells thick, with heavily carbonized walls, and an inner layer of thin-walled colorless cells; asci oval, 7–12 $\times$ 7–14 μ, irregularly distributed, eight spored, deliquescing at an early stage; spores lunate, 4–7 $\times$ 8–14 μ, smooth, extruded in light reddish-brown cirrhi 30–50 μ diameter and reaching a length of one mm.

Type culture isolated from an infection on a human hand. Slides from sub-cultures deposited at the New York Botanical Garden.

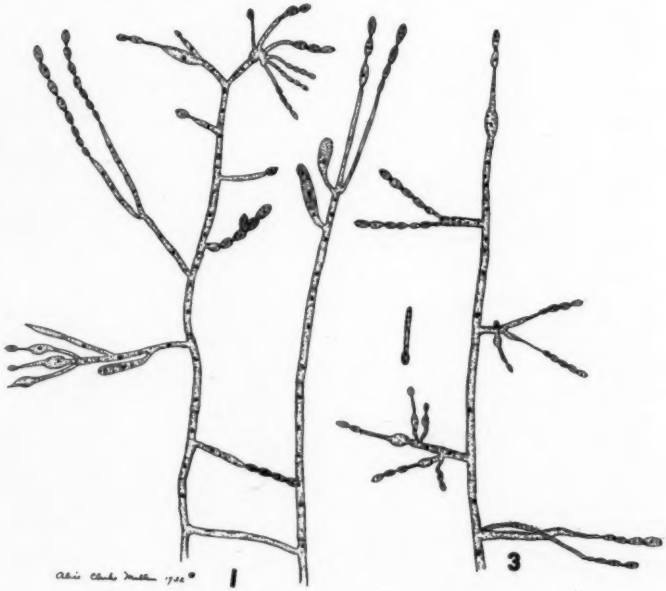
The conidial stage of this fungus is to be designated as **Scopulariopsis lunaspora** sp. nov.

The ascocarp arises from two cells which can readily be distinguished from the cells in the rest of the hyphae because these cells do not destain and always remain black while the rest of the sterile cells readily destain when stained with Haidenhain's iron haematoxylin, short method (FIG. 4–7). One of the dark staining cells first sends out dark stained ascogonium branch with one nucleus. The nucleus undergoes division as the ascogonium branches and a cross wall is formed separating each nucleus. The other dark staining cell, near or adjoining the dark staining cell that the ascogonium arose from, sends out a dark staining antheridium branch which is smaller than the ascogonium branch. The nucleus in the antheridial branch divides and the dark staining antheridial branch becomes septate.

The antheridium coils around the ascogonium branch. The nucleus from one cell in the antheridium passes over into a branch of the ascogonium and becomes paired with the ascogonium nucleus.

Rapid division of the nuclei follows as the ascogenous hyphae branch. The sterile cells in the original hyphae then begin to put forth hyphae which bend towards the ascogenous hyphae and begin to envelop or twine around the ascogenous (from this stage, one is dependent on sections through the perithecium). The ascogenous hyphae become enveloped in a hypha weft of several layers of cells. This envelope later becomes differentiated into an

outer wall of dark colored carbonized cells and an inner portion consisting of thin-walled colorless cells. The cells immediately surrounding the ascogenous hyphae began to elongate inwardly, crowding in to fill up the space made available because of intercalary growth of the outer wall. A papillate ostiolar portion is then organized and its cavity forms schizogenetically. Because the outer wall increases in its circumference more rapidly below and at



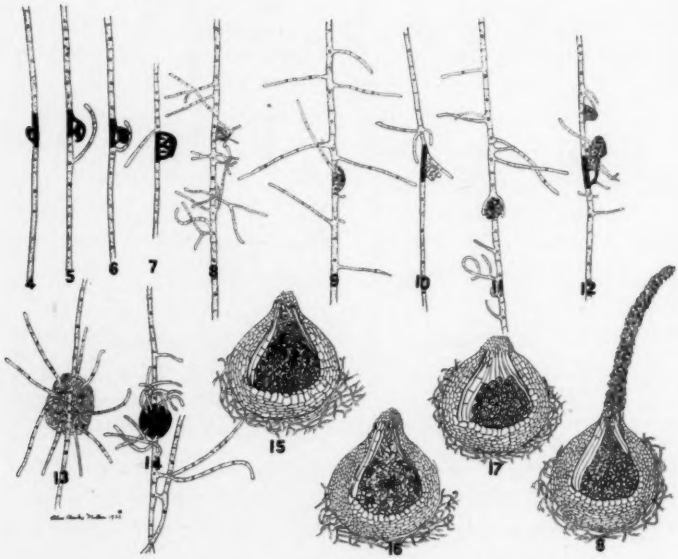
FIGS. 1–3.

the sides than at the top, and because the inward-growing hyphae develop more rapidly from below than from above, the ascogenous hyphae become placed well above the center and just beneath the ostiole. The ascogenous hyphae branch in a downward direction. The asci arise as side or terminal branches of the ascogenous hyphae. The first asci form in the region near the location of the ascogone. The ripening of asci proceeds from this region peripherally, following the direction of growth of the ascogenous hyphae. The sterile cells are gradually absorbed and their place in

the cavity is taken by ascospores set free as the asci deliquesce. The ascospores are discharged in large, slender cirrhi containing a cementing substance which hardens on drying and which is then dissolved in water only, very slowly.

ASEXUAL STAGE

The mycelium is composed of branching septate hyphae 2 to 3 μ in diameter. The conidiophores may be lacking, or when present are either simple or branched. The conidiophore may bear at the tip, a chain of spores, a single vertical sterigma or a many branched sterigma 5 to 12 μ long. The conidia are brown oval to lemon shape, with a collar at the base 2–4 $\times$ 4–7 μ. Germination takes place from the side.

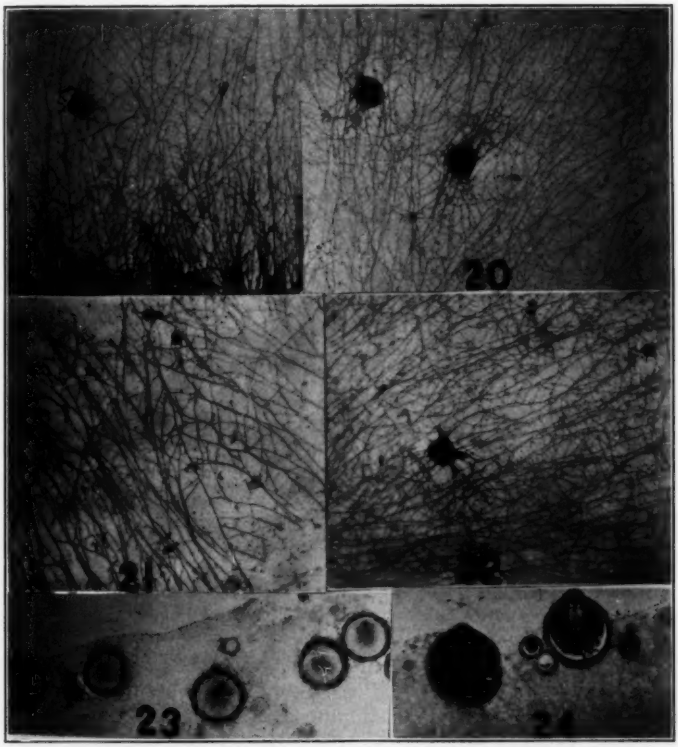


FIGS. 4–18.

SEXUAL STAGE

Ascogonium is coiled. The antheridium generally comes from the adjoining cell in the same hypha. The ascocarps have papil-

late ostiole with a beak, 175 to 300 μ in diameter in Knop's solution. The outer five to eight layers of cells are heavily carbonized, the ascogenous hyphae grow downward from the ascogonium which is then located well up under the ostiole. Asci are oval and 7–12 $\times$ 7–14 μ. The asci are irregularly distributed and in gen-



FIGS. 19–24.

eral, orientated towards the periphery of the ascocarp and away from the ascogonium. The asci are eight-spored and are deliquescent within the ascocarp. Ascospores are lunate-shaped 4–7 $\times$ 8–14 μ and are discharged from the dying ascocarp as a long, light reddish-brown cirrhus 30–50 μ in diameter and reaching a length of one mm. (FIG. 17).

DISCUSSION

The technique employed in growing, fixing and staining these fungi is different from that usually followed by mycologists and will be described in a later paper.

This new species is very similar to *Microascus trigonosporus*. Since *M. trigonosporus* has been excellently described by Emmons and Dodge (**1**), I will not give a full description of this *Scopulariopsis* in this paper but will relate certain details in which it differs from *M. trigonosporus*.

I have found that this species of *Scopulariopsis* is an ascomycete with a *Scopulariopsis* conidial stage and an ascocarp stage which corresponds to *Microascus* except that it has lunate-shaped ascospores. *Microascus sordidus* has kidney-shaped ascospores and *Microascus trigonosporus* has triangular ascospores.

This new species of *Scopulariopsis* described as *Microascus lunasporus* and the conidial stage is referred to as *Scopulariopsis lunaspora*.

Emmons and Dodge (**1**) did not describe the asexual stage in *Microascus intermedius*, therefore, I cannot compare that species with *Microascus lunasporus*. I have five different species growing now in which the sexual stages are quite similar but there is a marked difference in the asexual stage of each and in the cultural habits especially in their power to reduce cellulose. These five species will be described fully in a later paper.

Prepared slides deposited at The New York Botanical Garden.

SUMMARY

The writer has studied in culture an ascomycete having a *Scopularopsis* conidial stage and an ascocarp stage very similar to the one described by Emmons and Dodge which corresponds to *Microascus* except that it has lunate-shaped ascospores whereas *Microascus trigonosporus* has triangular ascospores and *Microascus sordidus* has kidney-shaped ascospores. The new species is described as *Microascus lunasporus*. The ascocarp arises from two cells which shows great affinity for Haidenhain's haematoxylin stain, the ascogenous hyphae coming from one cell and the antheridium from the other. The antheridium is septate and fertilizes

the ascogenous hyphae in the two-cell stage. After pairing, the nuclei undergo rapid division as the ascogenous hyphae becomes enveloped in a hypha weft of several layers of cells. Later this envelope becomes differentiated into an outer wall of dark-colored carbonized cells and an inner portion consisting of thin-walled colorless cells. These sterile cells are gradually absorbed and their place in the cavity is taken by ascospores set free as the asci deliquesce. The ascospores are discharged in long cirrhi containing a cementing substance which hardens on drying and which then is dissolved in water only very slowly.

BUREAU OF PLANT INDUSTRY,
HARRISBURG, PENNSYLVANIA

EXPLANATION OF FIGURES

Fig. 1, enastomosing hyphae with nuclei showing conidiophores and conidia; 2, conidia germinating; 3, simple hyphae with conidia; 4, two cells in hyphae staining dark, one cell producing an ascogenous hyphae and the other dark cell will produce the antheridium; 5 and 7, ascogenous hyphae branched with nucleus in each branch; the septate antheridium fertilizing the ascogenous hyphae, while the sterile hypha is curving in to form the perithecium wall; 6, ascogenous hypha nuclei undergoing rapid division as the sterile hypha bends in; 8, adjoining hyphae will shoot out a branch hypha when they lie near the formation of an ascocarp on a different hypha; 9–12, the nuclei after fertilization undergo rapid division before the ascocarp is formed; 13 and 14, ascocarp formed; 15, medium longitudinal section of a perithecium showing the papillate ostiole and the formation of asci; 16 and 17, section through a mature ascocarp filled with asci; 18, ascospores being extruded from the ascocarp in a cirrhus.

A NOTE ON THE TEMPERATURE RELATIONS OF CERTAIN FUNGI

NEIL E. STEVENS

(WITH 1 FIGURE)

Advantage was taken of an unusually accurate series of temperature chambers, which have been maintained for more than a year under the immediate care of Dr. A. G. Johnson in the laboratory of the Division of Cereal Crops and Diseases of the Bureau of Plant Industry, to test in culture the temperature relations of the species of "*Diplodia*" common on corn, as well as of a group of apparently closely related fungi which the writer has been studying for a number of years. The temperature intervals are 5° C., and it is thus not possible to determine exact maximum or optimum temperatures with great accuracy. This, however, does not seem important since it is their relative growth which is of greatest interest.

The method used was to grow the fungi on agar plates from mycelial transfers, average a number of different series, usually 6 to 10, run at different times, and reduce all readings to radial growth in a 24-hour period. Results of the tests on corn meal agar are given in the graphs (FIG. 1). Other culture media were used and, of course, the growth rate varied somewhat with the medium. The relative rate, however, remained the same. None of the fungi showed measurable growth at 5° or at 40°. No doubt, within each of these morphological species there could be found races with temperature relations somewhat different from those here indicated, but these are believed to be typical, and are averages of available material, including in as many cases as possible cultures originating from ascospores and pycnospores. Without attempting to insist on their significance, attention may be directed to certain apparent correlations.

GEOGRAPHICAL DISTRIBUTION

Diplodia Zeae (Schw.) Lév., the common corn "*Diplodia*," apparently occurs to some extent almost throughout the range of its host, but is least important toward the northern limits of corn cultivation, and in the drier areas.

Diplodia macrospora Earle is less well-known but has been reported on corn from the United States, South America, and South Africa.

Physalospora obtusa (Schw.) Cooke (*Sphaeropsis malorum* Peck) (cause of the common black rot of apple). This fungus is abundant throughout the eastern United States, rare in California, present but apparently not abundant in Europe.

Diplodia megalospora Berk. & Curt. has been reported from South Africa and is scattered but apparently not particularly abundant throughout the eastern United States from Virginia northward.

Botryosphaeria Ribis G. & D. is widely scattered in the tropics and common in southeastern United States. One form (*chromogena*) causes the cane blight of currant, destructive during certain periods as far north as the Hudson Valley, New York.

Botryosphaeria melanops (Tul.) Winter has been collected much more rarely than the preceding, and has been found thus far only in Europe and the northeastern United States.

Physalospora mutila (Fries) N. E. Stev. (*Sphaeropsis malorum* of Berkeley) is fairly common in Europe and occasionally found in the northwestern United States.

Physalospora glandicola (Schw.) N. E. Stev. has been collected only a few times, all in the northeastern United States and adjacent Canada.

Diplodia natalensis Pole-Evans is common and widely distributed in the tropics, and in the southeastern United States.

Diplodia sarmentorum Fries is very common in Europe and occasionally found in the northwestern United States.

Comparison of the temperature relations of these fungi with their known distribution shows that the corn fungi have a relatively narrow temperature range, with no growth at 10° or 35° C.

Within the "Melanops" group (*Botryosphaeria* and *Physalospora*) two species only show any considerable growth at 35° C.

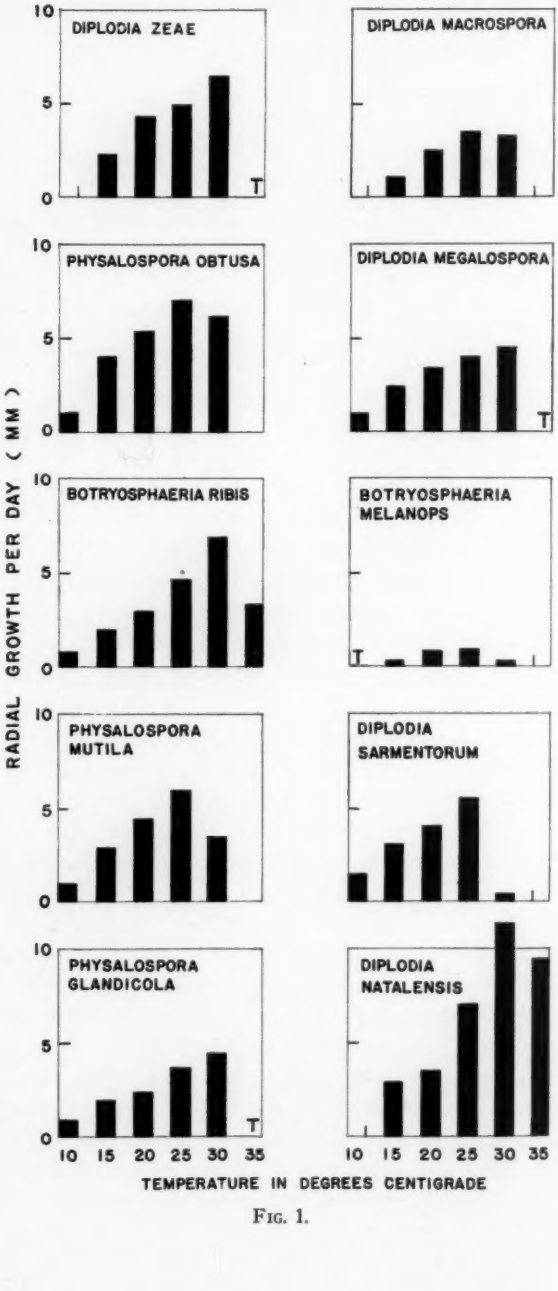

DIPLODIA ZEAE
DIPLODIA MACROSPORA
PHYSALOSPORA OBTUSA
DIPLODIA MEGALOSPORA
BOTRYOSPHAERIA RIBIS
BOTRYOSPHAERIA MELANOPS
PHYSALOSPORA MUTILA
DIPLODIA SARMENTORUM
PHYSALOSPORA GLANDICOLA
DIPLODIA NATALENSIS
RADIAL GROWTH PER DAY (MM)
0
5
10
T
10 15 20 25 30 35
TEMPERATURE IN DEGREES CENTIGRADE

FIG. 1.

These are *Botryosphaeria Ribis* and *Diplodia natalensis*, both of which are widely distributed in the tropics. Species whose range is well known and which are relatively abundant in the North Temperate regions all show good growth at 10°, and have their optima around 25° or 30°, *i.e.*, *Physalospora glandicola*, *P. obtusa*, *P. mutila*, *Diplodia sarmentorum*, *D. megalospora*, and *Botryosphaeria Ribis*. The one with the widest temperature range is *B. Ribis*, which has also the greatest known north and south distribution. It would, of course, be unwise to push these correlations too far but if similar information had been available 20 years ago, when we first took up the study of the currant cane blight caused by *B. Ribis*, we might not have delayed 10 or 12 years before looking for this fungus in the tropics.

SIZE OF SPORE AND GROWTH RATE

Included in the study were three " pairs " of species very similar in general appearance and in shape of pycnospores, but in each case the pycnospores of one are much larger than those of its countertype. The pairs are, with the small-spored fungus named first in ecah case, *Diplodia Zeae* and *D. macrospora*, *Physalospora obtusa* and *D. megalospora*, *Botryosphaeria Ribis* and *B. melanops*. So similar except for size are the pycnospores of these " pairs " within the " Melanops " group that it is easy to deceive even a very skilled observer as to their identity by changing the objective of the microscope. In the case of the two species of *Botryosphaeria*, of which alone the ascospore stage is known in both members of the pair, the same relation exists in the ascospores, *i.e.*, they are identical in shape and general appearance, but *B. melanops* is much larger than *B. Ribis*.

It will be noted that the *ranges* of the two members of each " pair " are much the same, but that in each case (and this applies on all culture media tried) the growth rate of the larger spored fungus is much slower, also that the larger spored form is apparently much less common and apparently less widely distributed in nature. Continued study of these fungi leads to the conviction that in some way not yet understood, these phenomena are related in a significant manner.

BUREAU OF PLANT INDUSTRY,
WASHINGTON, D. C.

NORTH AMERICAN SPECIES OF SCLEROTINIA AND RELATED GENERA.[1] III. CIBORIA ACERINA[2]

H. H. Whetzel and N. Fabritius Buchwald[3]

(with 19 figures)

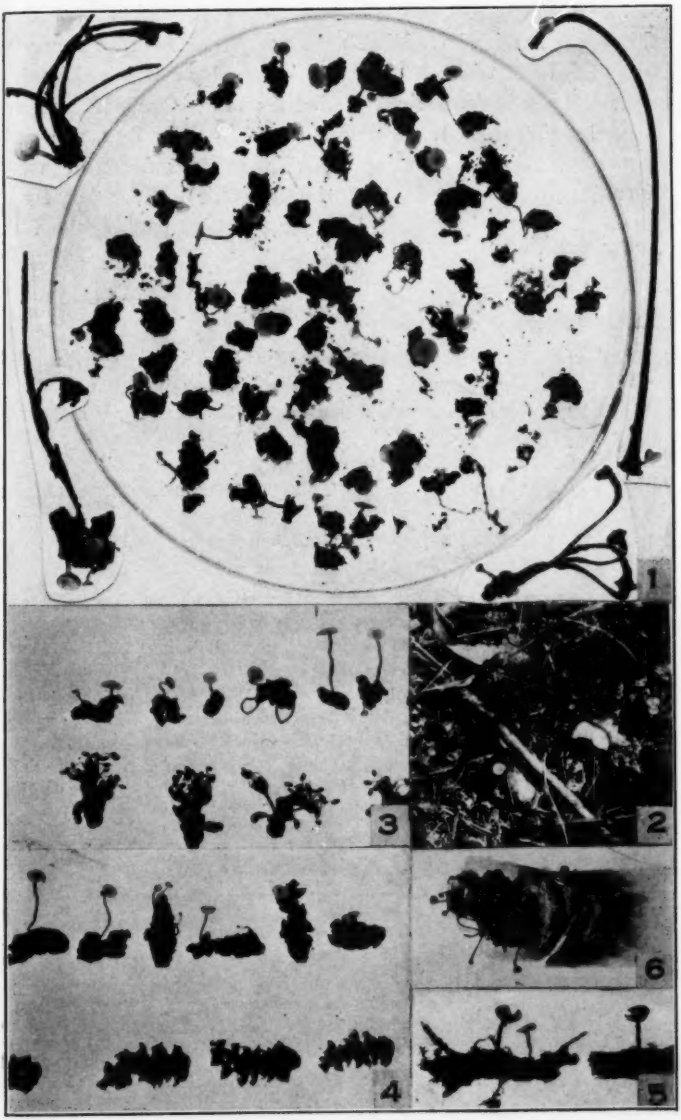
This species was first collected by E. E. Honey in 1926, in the South Hill Swamp, Ithaca, N. Y., on the overwintered staminate inflorescence of *Acer rubrum*. It has been taken by the senior author nearly every spring since that time on *Acer saccharinum* (fig. 1) and *A. rubrum* (fig. 3) in localities about Ithaca, N. Y. It appears to be very common and is usually abundant on these hosts. It was collected on the overwintered female inflorescence of *A. rubrum* at Malloryville, N. Y., April 15, 1936; on male catkins of *Myrica Gale* (fig. 4), at Labrador Lake, N. Y., April 18, 1927; on male catkins of *Salix discolor* (fig. 5) in the Lloyd Preserve at McLean, N. Y., on May 1, 1928; and in the same locality on what appears to be a bud (male inflorescence) of *Ostrya virginiana*, May 5, 1933. It occurs in great abundance every spring on the over-wintered male inflorescences of *Acer saccharinum* on the campus of Cornell University.

This is one of the earliest species of *Ciboria* occurring in the region about Ithaca, its apothecia maturing and discharging the ascospores during April and May when its hosts are in bloom. The minute apothecia, 2–3 mm. in diameter, are usually to be found at this time in great numbers on the ground among the grass and leaves, beneath trees of the silver maple and red maple

[1] The title of this series of papers, of which two have already appeared, is thus modified to designate more adequately the field into which the senior author's taxonomic wanderings have led him.

[2] The investigations upon which this paper is based were supported in part by a grant from the Heckscher Foundation for the Advancement of Research, established by August Heckscher at Cornell University. The writers wish to acknowledge the assistance of Miss Cynthia Westcott, who, as Heckscher Research Assistant, contributed materially to the success of this investigation. The photographs were taken by W. R. Fisher. The drawings are by the junior author and Miss Ruby Rice.

[3] Fellow of the International Education Board, 1930–31.



FIGS. 1–6. *Ciboria acerina.*

(FIG. 2). They arise, one to several, from the black, mummified inflorescences which have lain on the ground through the previous summer, fall and winter. The species is readily recognized by the very small apothecia, the mummified flowers of its hosts and its 4-spored asci (FIG. 13). A thorough search of the literature discloses no already-described species to which our fungus can be referred (see *Notes* at the end of this article). We, therefore, present it as a newly described species to which we give the following name:

DESCRIPTION

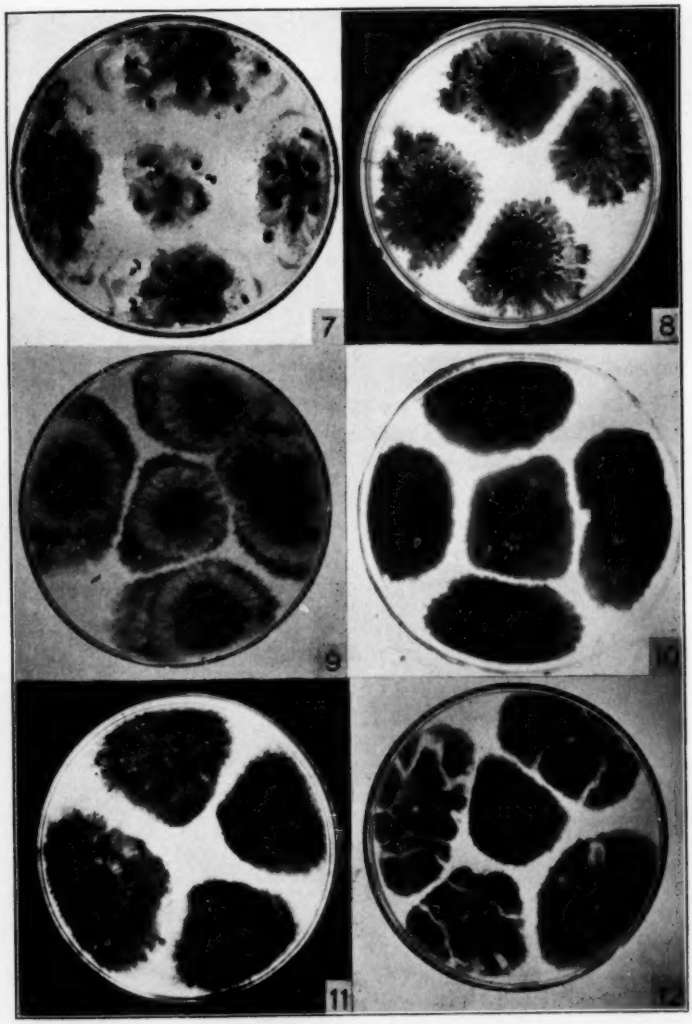
Ciboria acerina sp. nov.

Apothecia 1–several, from the black stromatized male (rarely the female) inflorescence of the host; small, 1–4 mm., usually 2–3 mm. in diameter. Disc wood brown, avellaneous or vinaceous buff (R [4]); broadly funnel-form to shallow cup-shaped, finally flat-expanded; margin often recurved in mature specimens. Stipe variable in length, 1–10 mm. long, smooth, somewhat darker than the cup. Under side of cup and stipe finely pubescent when young. Asci short and stout, 75–107 × 7.5–8.8 μ, average 92 × 7.7 μ, mode 90 × 7.5 μ,[5] always 4-spored; ascospores ellipsoid, slightly flattened

[4] R = Ridgway's Color Chart. The young apothecia are light colored, vinaceous buff, becoming avellaneous, finally wood brown with age.

[5] These figures are the results of measurements of 100 asci and 100 ascospores made on living material of the type specimen (*21961*). Similar measurements from some twenty collections (usually 50 asci and 100 ascospores) show relatively little variation. Variations in measurements of asci are usually of little significance, especially the length, which in these twenty-odd collections averages somewhat less than that of the type specimen. The following table will give some idea of the variation in size of ascospores to be expected in different collections of this species:

Collection	No. sp.	Limits (in microns)	Average μ	Mode μ
Acer saccharinum				
Herb. No. *21961*.....	100	10.0–15.0 × 5.0–6.2	11.9 × 5.5	11.2 × 5.0
23397.....	100	7.5–16.3 × 3.8–6.3	11.9 × 5.9	11.9 × 5.0
Acer rubrum				
Herb. No. *15787*.....	100	7.2–13.2 × 3.6–7.8	10.1 × 5.2	10.2 × 4.8
17461.....	100	10.2–14.4 × 3.6–6.6	12.0 × 5.4	12.0 × 5.4
17471.....	50	9.6–15.6 × 4.2–7.2	12.0 × 5.6	12.6 × 6.0
Myrica Gale				
Herb. No. *15152*.....	100	8.7–15.7 × 4.3–7.0	11.7 × 5.2	11.5 × 5.1
15791.....	100	7.8–13.2 × 3.6–6.0	10.2 × 4.5	10.2 × 4.2
Salix discolor				
Herb. No. *17469*.....	100	7.2–12.0 × 3.6–6.0	9.2 × 4.6	9.0 × 4.8
Ostrya virginiana				
Herb. No. *25110*.....	100	7.5–15.0 × 3.8–6.3	11.1 × 4.9	11.3 × 5.0



FIGS. 7–12. *Ciboria acerina.*

on one side, hyaline, smooth, occupying the upper two-thirds of the ascus, uniseriate, 10–15 × 5–6 μ, average 11.9 × 5.5 μ, mode 11 × 5 μ.[5] Paraphyses simple, slender, septate, gradually enlarging toward the tip, slightly longer than the asci. Microconidia globose, about 3 μ in diameter, borne on fasciculate, Indian-club-shaped conidiophores of the usual *Sclerotinia* type. On the overwintered male and female inflorescences of *Acer rubrum* L., and on the male inflorescences of *Acer saccharinum* L., *Myrica Gale* L., *Salix discolor* Muhl., and *Ostrya virginiana* (Mill.) K. Koch, on the ground or in leaf mold under the host. Known only from North America.

HERBARIUM MATERIAL. Type specimen, No. *21961,* Plant Path. Herb. Cornell University on *Acer saccharinum.* Duplicate material from this same collection has been deposited in the following herbaria: Harvard University; The New York Botanical Garden; Kew Gardens, England; British Museum, London; Museum d'Histoire Naturelle, Paris; University of Upsala, Sweden; University of Toronto, Canada; University of Copenhagen, Denmark; and Mycological Collections, Bu. Pl. Ind., Washington, D. C.

The following additional collections among others are deposited in the herbarium of the Department of Plant Pathology, Cornell University, Ithaca, New York.

On *Acer saccharinum* L., Nos. *23397, 25106, 25109.*
Acer rubrum L., Nos. *14178, 15153, 15787, 16191, 17470, 17471, 25247* (Female inflorescence).
Myrica Gale L., Nos. *15152, 15791, 25105.*
Salix discolor Muhl., Nos. *17469, 16703.*
Ostrya virginiana (Mill.) K. Koch., No. *25110.*

CULTURAL CHARACTERS

Ascospore sowings on potato dextrose agar give a rapid mycelial growth. There is a fairly abundant development of webby aerial mycelium, being rather scanty in isolates from *A. saccharinum* but profuse and felty in isolates from *A. rubrum* (compare figures 7 and 10). At first white, the aerial mycelium gradually becomes greyish brown, especially in isolates from *A. rubrum* and *Myrica Gale.* As the stromata develop on the surface of the agar

the aerial mycelium becomes appressed forming a more or less dense felty covering over them.

The submerged mycelium is hyaline and sparse in isolates from *A. saccharinum*. Isolates from the other hosts produce a very abbundant dense submerged mycelium, which quickly becomes dark brown, eventually almost black (FIG. 10, 11). In isolates from *A. saccharinum*, while the submerged mycelium slowly takes on the brown color, the hyphal mat never becomes dark brown due to the relatively sparse hyphal development (FIG. 7). Seen through the bottom of the plate, isolates from *A. rubrum* have an opalescent, bluish-black color over the central portion of the growth. The dark-brown margins are crenate or feathery.

The stromata develop as rather small, irregular, flat, thin crusts on the surface of the agar, strikingly evident in isolates from *A. saccharinum* (FIG. 7) but more or less hidden in isolates from the other hosts by the dark brown mat of aerial mycelium covering them; usually more or less zonately disposed.

LIFE HISTORY

Some special investigations made by the junior author during the spring of 1931 may first be briefly summarized.

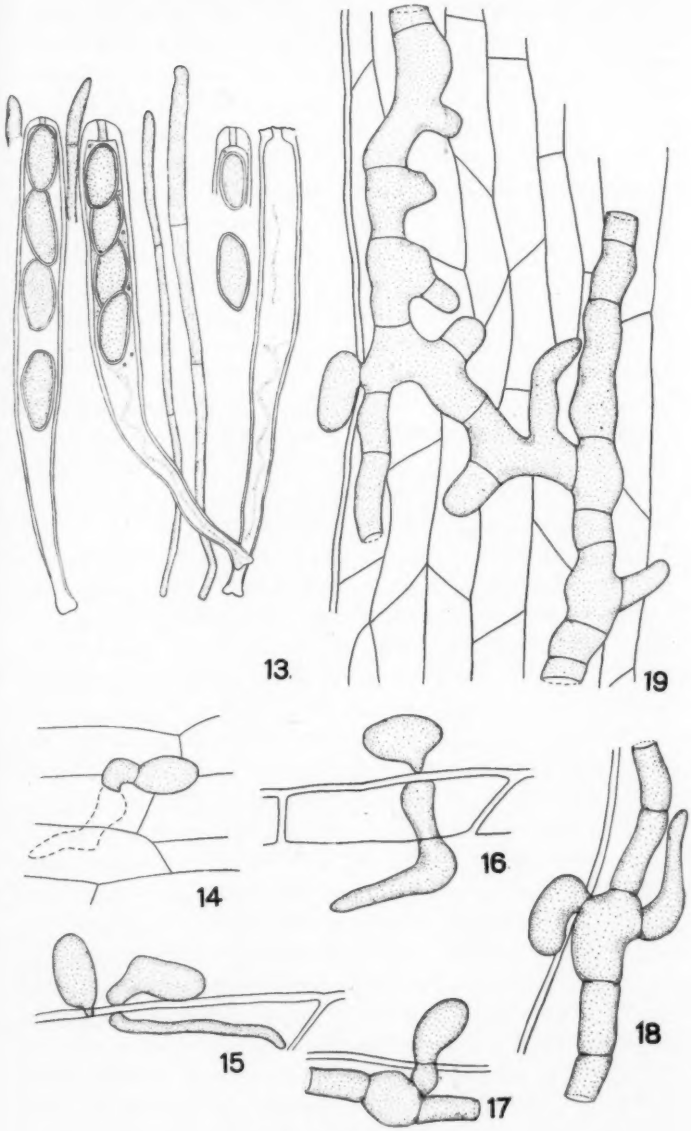
Experiments on incubation and infection. In order to determine whether *Ciboria acerina* is parasitic in the early stage of its life history, the following experiments were undertaken.

Twigs of *Acer rubrum* were cut on April 12, 1931, placed in water, and covered with a bell jar. Well-developed apothecia of *Ciboria acerina* were fastened to the twigs in such a position that the discharging ascospores would fall in abundance on the open flowers. Flowering twigs under another bell jar served as checks. After forty-eight hours, the bell jars were removed. The inoculated flowers already showed evidences of infection. They had begun to wither, while those in the checks were still fresh. Microscopic examination was made of the stamens and other floral parts at intervals of one, three, and six days after inoculation. The tissues of the inoculated flowers were stained in cotton blue lacto-phenol, and cleared in lacto-phenol. The germinating ascospores and mycelium took on a deep blue color, while the host tissues

remained unstained or of a much lighter blue color. The protoplasmic contents of the hyphae or of the host cells only were stained. It was observed that the ascospores had already germinated on the stamens after 24 hours, but in only a few cases had the germ tubes penetrated the epidermis (FIG. 14–16). After a period of seventy-two hours their germ tubes had penetrated the epidermis in great numbers, and rapid invasion of the tissues was under way (FIG. 17–19). After six days the filaments were found to be invested completely with mycelium. Spores which had fallen on the calyx and bud scales had germinated weakly or not at all, and there was no evidence of penetration. No trace of mycelium could be found in the stamens of the flowers in the check.

In order to determine whether this process of penetration and invasion of the stamens takes place under natural conditions in the flowers on the trees, staminate flowers were taken from a tree of *Acer saccharinum* underneath which there was an abundance of mature apothecia discharging spores. Using sterile instruments, anthers and filaments were carefully planted in potato dextrose agar in poured petri plates. At the same time apothecia were suspended above similar plates of potato dextrose agar and allowed to discharge their spores. Cultures thus obtained from the germinating ascospores and from the bits of planted stamens gave mycelial growths which were indistinguishable when compared. Transfers of mycelium from ascospore sowings and from the plantings of infected stamens were grown together side by side on potato dextrose agar in the same petri dish. Growing thus together, under identical conditions, no differences were to be observed in the mycelial growths from these two sources, indicating quite clearly that the fungus obtained from the tissue plantings of the stamens arose from invasion by *Ciboria acerina* which had already taken place while the flowers were still on the trees.

To make sure, however, that cultures obtained by tissue plantings from these stamens had not originated simply from ascospores adhering to the surface of the stamens, flowers which presumably were already infected were collected on April 20, 1931, from the trees of *Acer saccharinum* under which apothecia were abundant. Microscopic studies of these stamens stained with cotton blue as



FIGS. 13–19. *Ciboria acerina.*

described above showed numerous germinating ascospores, and in many cases the filaments were completely invaded by the mycelium.

Thus by microscopic examination of artificially inoculated flowers and of flowers naturally inoculated, as well as by comparison of cultures made from ascospore sowings and from tissue plantings from infected flowers, it seems to be clearly demonstrated that this fungus is parasitic upon the anthers and filaments of living stamens, and thus that invasion and initial infection of the hosts of *Ciboria acerina* occur only through the stamens. No evidence of infection of female flower parts was obtained although they also were inoculated. However, the discovery in the spring of 1936 of apothecia of what is undoubtedly *C. acerina* on the overwintered pedicels of female flowers of *A. rubrum* indicates that these organs are attacked in nature, although perhaps rarely.

Outline of life history. From these studies and from extensive field observations by the senior author over a period of ten years, the essential features of the life history of this *Ciboria* as it occurs on its *Acer* hosts may be outlined as follows.

The apothecia developing from the stromatized inflorescences and bud scales mature and begin the discharge of the ascospores at the time the flowers of the maples are beginning to open. At Ithaca, New York, spore discharge usually begins late in March or early April, depending on the character of the spring weather. Specimens of mature apothecia still discharging spores may be found usually over a period of three to four weeks. The latest time at which collections of this fungus have been made is May 21. During essentially this same period, collections of mature apothecia are to be found occasionally on the male catkins of *Myrica Gale* and *Salix discolor* in localities where the fungus is abundant under neighboring trees of *Acer rubrum*. Three collections on *Myrica* and two on *Salix* have been taken thus far. One collection has been taken on a single overwintered bud of what is apparently *Ostrya virginiana*. It is probably common and abundant on *Myrica,* but apparently rare on *Salix discolor,* because every spring for twenty years the writer has looked for and collected *Ciboria caucus* on the male catkins of *Salix* species. If *Ciboria acerina* were common on the male catkins of willows, many more collections should have been taken on this host. It is reasonable to

assume, however, that the life history of the fungus on *Myrica* and *Salix* does not differ essentially from that on its *Acer* hosts.

The ascospores are discharged in great numbers from the mature apothecia. It is a common experience when removing dead grass or leaves in collecting these apothecia to observe the little white puffs of spores shot forth from the uncovered cups. Caught by air currents, the ascospores are carried upward through the trees, some of them lodging on the exposed anthers of the staminate flowers. During the period when these spores are being discharged, the air is usually moist from frequent rains, so that the humidity of the air and the moisture on the flowers are both very favorable to the dissemination and germination of the spores.

The junior author's experiments indicate that moisture on the flowers for a period of at least twenty-four hours is necessary to insure germination of the spores and penetration of the germ tubes into the anthers. After seventy-two hours of favorable conditions practically all of the spores will have germinated and their germ tubes will have entered the tissues of the flowers.

It appears from our observations that in the male flowers the stamens only are susceptible to invasion by the fungus. How invasion of the female inflorescence occurs is not known. Spores which were observed to have germinated on the bud scales or on the calyx of the flower were not observed to have penetrated the tissues of these organs. Invasion may occur either through the anthers or through the filaments of the stamens. The germinating ascospore usually sends a penetration tube from one end directly through the wall of the epidermal cell on which it is lying (FIG. 15). Sometimes this penetration tube is markedly constricted (FIG. 16), but in other cases there is little or no constriction (FIG. 17). The mycelium spreads intercellularly within the tissues, branches freely and is at first relatively large in diameter, the segments being more or less swollen (FIG. 19). Secondary hyphae are uniform in diameter and densely interwoven.

The mycelium spreads rapidly throughout the stamens and into the tissues of the calyx, pedicels, and out into the bud scales which form a cup-like structure about the cluster of flowers (FIG. 3). These flower clusters surrounded by the bud scales drop from the trees to the moist ground. Here the mycelium rapidly invades all

the tissues of this detached flower cluster, converting it into a stromatized mummy (FIG. 1, 3, 4). The cells of the floral parts, as well as those of the bud scales, are largely disorganized and destroyed, being replaced by a dense stroma of fungous mycelium. Remnants of host cells are to be found in this stroma. These stromatized floral clusters retain, more or less, their natural form. The outer layer of hyphae, which occupies the epidermal cells, becomes dark-colored, forming a true rind, while within the densely interwoven, thick-walled hyphae form a typical white medulla.

This stromatized flower cluster lies on the ground through the winter. In the early spring one to several apothecial fundaments may be observed arising from any part of the mummy (FIG. 1, 3, 4). Microconidia are produced by the fungus in pure culture, and almost certainly appear in abundance in nature but have not yet been observed by the writers. They doubtless function in the fertilization of the apothecial fundaments as is known to be the case in *Sclerotinia Gladioli*, as described by Drayton (**1932**, **1934a**, **1934b**).

There is no evidence that this fungus has any true conidial stage, and this, together with its characters in culture, clearly places it in the genus *Ciboria*.

NOTES

1. The only 4-spored species with which *C. acerina* might be confused, as far as the writers have discovered, is *Peziza incondita* Ellis (N. A. Fungi No. *391*), another 4-spored species (Ellis **1881**, Saccardo **1889**). A critical examination of the type material of *P. incondita* shows clearly that our species is quite distinct. The apothecia of *P. incondita* arise from a distinct, flattened, rugose sclerotium, not from a stromatized inflorescence as is the case with *C. acerina*. The ascospores are distinctly smaller than those of *C. acerina*. All collections of *Peziza incondita* which we have seen were taken during late June or early July, while apothecia of *C. acerina* mature during April and the early part of May. The specimen in the Durand Collection No. *4561*, labeled *Peziza gracilipes* var. *tetraspora* Ellis, is presumably a part of the specimen now in The New York Botanical Garden Herbarium enclosed in a separate packet with one of Ellis' collections of *P. gracilipes* of

June 25, 1875, and which bears the label, "*Peziza gracilipes* Cooke var. *tetraspora* mihi" in Ellis' hand-writing. A note on the packet made at a later date, presumably by Ellis, indicates that this is *Peziza incondita* Ellis. Examination of the specimen confirms this. This variety name has never appeared in the literature as far as the writers can discover.

While no special attempt has been made to obtain the apothecial stage in pure culture, apothecia appeared once in an isolate from *Myrica Gale* (Herb. Spec. No. *15791*) growing on potato dextrose agar slant (FIG. 6); and again from another isolate in a petri dish culture on the same medium (FIG. 11). Spore shootings made on potato dextrose agar, from apothecia collected April 18, 1927, were transferred to test tube slants on April 22, 1927. On January 7, 1928, a cluster of apothecial fundaments were observed in this culture arising from stromata formed at the center of the planting. The agar bearing these fundaments was removed and put on moist filter paper in a moist chamber; the moist chamber was then placed in a well-lighted cool greenhouse. By June 20, 1928, many apothecia with long slender stipes had developed and matured (FIG. 6). The asci were typically 4-spored.

The senior author has made three collections (Nos. *15604, 15790,* and *25103*) of an 8-spored species on the male inflorescence of *Acer rubrum* L. on April 18, 1927, at McLean, New York, May 3, 1927, and May 11, 1928, at Malloryville, New York, respectively. This form differs from *C. acerina* not only as to number of spores in the ascus, but also in the smaller size of the ascospores, in the darker color of the cups, and in the character of the growth on potato dextrose agar (FIG. 12). In view of these marked differences, it can scarcely be regarded as an 8-spored form of *C. acerina.* The two collections of this form are not sufficient to warrant us in describing a new species at this time. It does seem desirable, however, to record the occurrence of an 8-spored form occurring with *C. acerina* on *Acer rubrum* in this region.

The striking difference in cultural characters of the isolates of *C. acerina* from *A. saccharinum* in comparison with those from the other hosts raises at once the question whether we may not here be dealing with two distinct species in the 4-spored forms. Since we have detected no other significant morphological differences among

them the cultural differences alone do not appear to warrant the establishment of more than one species. Whether or not these cultural characters are correlated with biologic specialization of the forms on the different host plants remains to be determined.

DEPARTMENT OF PLANT PATHOLOGY,
CORNELL UNIVERSITY,
ITHACA, NEW YORK

LITERATURE CITED

Drayton, F. L. The sexual function of the microconidia in certain discomycetes. Mycologia **24**: 345–348. 1932.

——. The sexual mechanism of *Sclerotinia Gladioli*. Mycologia **26**: 46–72. 1934a.

——. The gladiolus dry rot caused by *Sclerotinia Gladioli* (Massey) n. comb. Phytopath. **24**: 397–404. 1934b.

Ellis, J. B. *Peziza incondita*. *In* New Species of North American Fungi. Torrey Club Bull. **8**: 73–74. 1881.

Saccardo, P. A. *Sclerotinia incondita*. *In* Syll. Fung. **8**: 200. 1889.

EXPLANATION OF FIGURES

Fig. 1. A collection of apothecia on overwintered male inflorescences of *A. saccharinum* in a petri dish. *21961*. Around the petri dish female inflorescences bearing apothecia. *25247*. Natural size.

Fig. 2. Apothecia on overwintered male inflorescences of *A. saccharinum* as they appear on the ground among dead grass and leaf debris. Natural size. *21961*.

Fig. 3. Apothecia on overwintered inflorescences of *A. rubrum* together with blossom clusters taken from the trees at the time the apothecia were collected. Natural size. *15153*.

Fig. 4. Apothecia on overwintered male catkins of *Myrica Gale* with flowering catkins taken from the branches at the same time. Natural size. *15152*.

Fig. 5. Apothecia on overwintered catkins of *Salix discolor*. Natural size. *17469*.

Fig. 6. Apothecia developed on potato agar slant by isolate from *Myrica Gale*. Natural size. *15791*.

Plantings of ascospore isolates on potato dextrose agar at room temperature. Reduced ½.

Fig. 7. Isolate from *A. saccharinum* about 25 days old. *23397*.

Fig. 8. Isolate from *S. discolor* about 20 days old. *16703*.

Fig. 9. Isolate from *A. rubrum* about 14 days old; stromatic crust not yet formed; aerial mycelium still white. *15153*.

Fig. 10. Isolate from *A. rubrum* about 20 days old. *16191*.

Fig. 11. Isolate from *Myrica Gale* about 20 days old. *15152*. Note the apothecium growing from the margin of the lower left planting.

Fig. 12. Isolate from 8-spored unnamed species on *A. rubrum* about 20 days old. *15604.*

All figures magnified approximately 900 times.

Fig. 13. Asci, paraphyses and ascospores of *Ciboria acerina* from type material.

Fig. 14. Ascospore germinating and penetrating an epidermal cell of the stamen filament of *A. rubrum* 24 hours after artificial inoculation, surface view.

Fig. 15. Same as fig. 14 except showing two germinating spores in different stages of penetration in sectional view.

Fig. 16. Same as fig. 15, showing penetration and beginning of mycelial invasion of subepidermal tissues of the stamen filament.

Fig. 17. Penetration and invasion of tissues of the stamen filament of *A. rubrum,* 72 hours after artificial inoculation.

Fig. 18. Ascospore germination, penetration and invasion of tissues of the filament of *A. saccharinum.* Natural infection.

Fig. 19. Same as fig. 18, but showing more extensive invasion of the tissues of the filament; the large irregular and closely septate mycelium produced in the early stages of tissue invasion.

CULTURAL LIFE HISTORIES OF MELANCONIS AND PSEUDOVALSA. II[1]

LEWIS E. WEHMEYER

(WITH 5 FIGURES)

The genera *Melanconis* and *Pseudovalsa* represent a heterogeneous group of species whose relationships are most interesting. The limits of the family Melanconideae, in which they are placed by Winter (**8**, p. 764) are purely artificial. His family is based upon the type of conidial stage which is of "eigentümlicher Beschaffenheit" and consists of conidia born superficially upon a stroma. As a matter of fact, there are certain species in either *Melanconis, Pseudovalsa* or *Hercospora* in which the conidia are born more or less, or entirely, enclosed in locules. Von Höhnel's Diaportheen is a much more natural grouping, but in his original tabulation of genera (**3**) he does not include these genera, although his other writings show that he considered them closely related. The limits of such genera (or subgenera) as *Melanconis, Melanconiella, Pseudovalsa* and *Calosporella,* being based on color and septation of ascospores are likewise artificial. In fact, no single character can be used to express relationships in this group, for a consideration of the correlation of these characters soon reveals an intricate interrelated series, an unravelling of which demands a full knowledge of both stages in the life history of all species concerned. The genus *Melanconis,* for instance, is supposed to be associated with *Melanconium* conidial stages, but *M. thelebola* is associated with a *Stilbospora, M. modonia* and *M. perniciosa* with a *Coryneum* and *M. xanthostroma* and *M. sulphurea* with a *Myxosporium* or *Fusicoccum* conidial stage. The writer (**7**) has suggested that typical species of *Melanconis* are characterized by a well-developed ectostroma and the lack of blackened zones in the substratum. Many species have poorly developed ectostromata, however, and *M. thelebola* often shows marginal blackened zones,

[1] Papers from the Department of Botany and the Herbarium of the University of Michigan No. 580.

whereas *Melanconiella nigrospora* (*M. Meschuttii*) has a sharply outlined stromatic receptacle comparable to that found in *Hercospora*. A segregation of such variants as new genera, before a thorough consideration of this group of species as a whole, has merely added to the confusion. Similar examples could be advanced in the genus *Pseudovalsa*. It is believed, therefore, that information as to the structure and conidial connections of such atypical and of additional species will aid greatly in illuminating these relationships and help in the organization of more naturally related groups.

Melanconis pallida (Rehm) comb. nov.

This species was considered as new until an examination was made of the type collection of *Melanconiella pallida* Rehm, kindly sent by John Dearness. This was identical with material collected several times about Ann Arbor and once near Boxford, Massachusetts. It forms rounded or elongate swollen pustules (FIG. 1), commonly in confluent longitudinal series, on the surface of hickory twigs and is usually accompanied by a *Melanconium* stage (FIG. 1) with more widely erumpent and more angular pustules exposing a granular black spore mass. The ascospores of this species are sometimes irregular in shape, one cell being larger than the other (FIG. 3: 4). In one collection, from Ann Arbor, some perithecia showed a majority of one-celled ascospores, measuring 18–24 × 12.5–13.5 μ. A single ascus may contain only one-celled or both one- and two-celled spores (FIG. 3: 3). When found, these spores were too old to investigate culturally, but they seem to be the result of the failure of the cross-wall to be laid down.

Ascospores from a collection made near Brighton, Michigan, on May 23, 1935, were sprayed onto Leonian's agar on October 10, 1935. Germination was slow and it was not until after four days that appreciable germ tubes were visible and single spore isolations could be made. The spores swelled somewhat, measuring 42–45 × 15–20 μ upon germination. The spore wall was ruptured and one or several irregular masses of protoplasm emerged. From these several thick irregular germ hyphae, 3.5–6.5 μ in diameter, branched out and soon became septate. A number of these germ

masses from each spore gave rise to a densely branching growth of brownish hyphae about the spore. Growth on oatmeal agar was extremely slow, producing a colony only 1–2 cm. in diameter

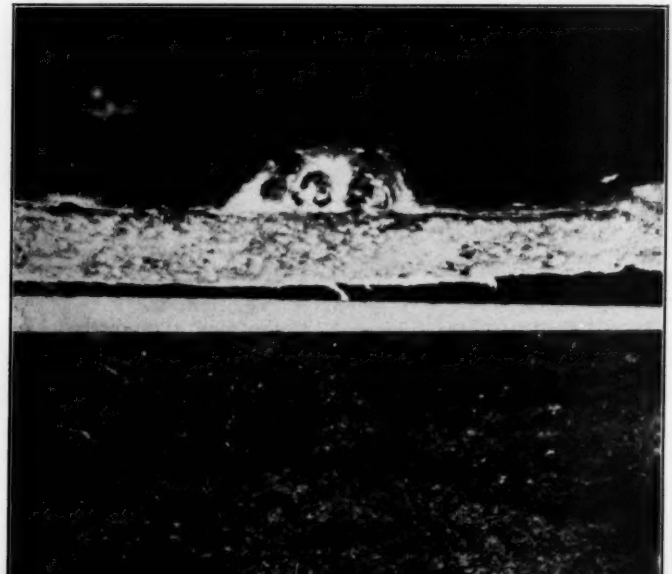


FIG. 1. *Melanconis pallida* Rehm: Radial section of perithecial stroma, above, and surface view of perithecial stroma and conidial stroma (*Melanconium intermedium* Peck), below. (× 20)

after two weeks growth. There were usually no superficial hyphae formed, but merely a deep yellow-brown discoloration of the medium from the submerged growth. In only one tube was there a

faint surface felt of olive-green hyphae in which a few tuberculate stromata were found. Conidia, of the same type as found on twigs were present in these stromata.

Inoculations onto autoclaved twigs of *Carya ovata* also gave a very slow growth with the formation of superficial grayish tuberculate stromata from which black watery spore masses were extruded. On one twig, more normal, imbedded, erumpent stromata with similar spore horns were produced. In this case the conidial stromata (FIG. 3: 1) were in the bark, entirely enclosed and entostromatic, but in nature they are often ectostromatic and on the bark surface. The conidia arose as the swollen tips of stout conidiophore hyphae lining the margin of numerous irregular cavities which soon coalesced, leaving an irregular mass of conidia lying within the stroma, without any definite marginal wall. The conidia (FIG. 3: 2) were subspheric to ovoid or oblong-cylindric, often with a flattened apiculus at the point of attachment, and measured 18–26.5 × 13.3–16.5 μ. The contents of the freshly formed conidium was coarsely granular and quite bright green giving an olive or greenish-brown color to the spore. The mature conidia were dark brown. No second type of conidium was seen.

Inasmuch as this species often occurs on rather freshly cut or killed branches, attempts were made to inoculate living *Carya* twigs which had been surface sterilized with mercuric bichloride, thoroughly washed in sterile water and placed in sterile test tubes. This treatment prevented surface growth of Penicillia and the like, but did not kill the twigs which continued to develop sprouts from their lateral buds. No infection with the *Melanconis* was obtained in any case, although a *Sphaeropsis* and several other fungi developed on the twigs. These were apparently present within the twigs when collected. This indicates that this species is not an active parasite but does not preclude its attacking weakened or freshly cut stems.

This species belongs to a group with grayish or greenish ectostromata and a *Melanconium* conidial stage such as *M. juglandinis*. This species shows an extreme condition of entostromatic development about the perithecia which, here, causes a pulvinate swelling on the surface. It also differs from other members of the group in the slight ectostromatic development which results in

a closely adherent periderm and a barely erumpent disc in the perithecial stromata. In the conidial stage, instead of open cavities on the flanks of an ectostroma, the stromatic development is either upon or within the bark cortex and is almost entirely used up in conidial formation, leaving a large mass of spores in an irregularly exposed cavity with very little stromatic base (FIG. 3: 1). The conidia commonly found associated with the perithecia in nature are similar to those obtained in culture and measure 18–26.5 × 13–16.5 μ. This conidial stage [2] is the same as the *Melanconium intermedium* of Peck. Ellis' N. Am. Fungi *3471* of *M. intermedium* on *Acer,* although given as "fide Peck," is not this species. The spores of this collection are more ovoid to pyriform and larger, measuring 21–31.5 × 18–22 μ. The type material of *M. intermedium* on hickory (N. Y. State Mus. Herb.; Buffalo, Jan. 16, G. W. Clinton and Greenbush, April, C. H. Peck), however, is typical of the *Melanconium* associated with *M. pallida.* In a letter to the writer, Dr. Dearness says, concerning the type of *M. pallida,* "I had carried this for a year as *Melanconiella larga.* Dr. Rehm would have adopted this name had he not accepted its relationship to *Melanconium pallidum.*" In the original description of *M. pallida* (**5**, p. 397), Rehm states, "Huc pertinet: *Melanconium pallidum* Peck conidiis oblongis obtusis, 1-cellularibus, subfuscis, 12–15 × 5–6 μ." The type collection of *Melanconiella pallida* shows two species of *Melanconium* on the same twigs. One of these, associated with the perithecial stromata, is *M. intermedium* Peck. The second, forming smaller, more conic, clustered pustules toward the end of one of the twigs, has light brown, oblong to elliptic conidia, measuring 11.5–18 × 5–6 μ and is *Melanconium gracile* Ellis & Ever. as represented in Ellis N. Am. Fungi *2864.* This is apparently what Rehm took for *M. pallidum.* The true *M. pallidum* [3] as shown by Peck's (**4**, p. 49) description and figures and by Ellis N. Am. Fungi *959,* has granular hyaline spores which are inaequilateral to curved and bear no resemblance to those found on Dearness' type material. It is barely possible that

[2] Ellis' N. Am. Fungi *120* of *Melanconium magnum* (Grev.) Berk. is also this species, but this binomial has probably been used for a number of *Melanconium* spp. on a variety of hosts.

[3] This species has been placed in the genus *Discosporium,* as *D. pallidum* (Peck) Höhn, by von Höhnel (Sitz.-ber. Akad. Wien. **125**: 100).

Melanconium pallidum may represent the beta conidial stage of *Melanconis pallida,* but there is no evidence, as yet, for this. This association of several species of *Melanconium* on the same twig

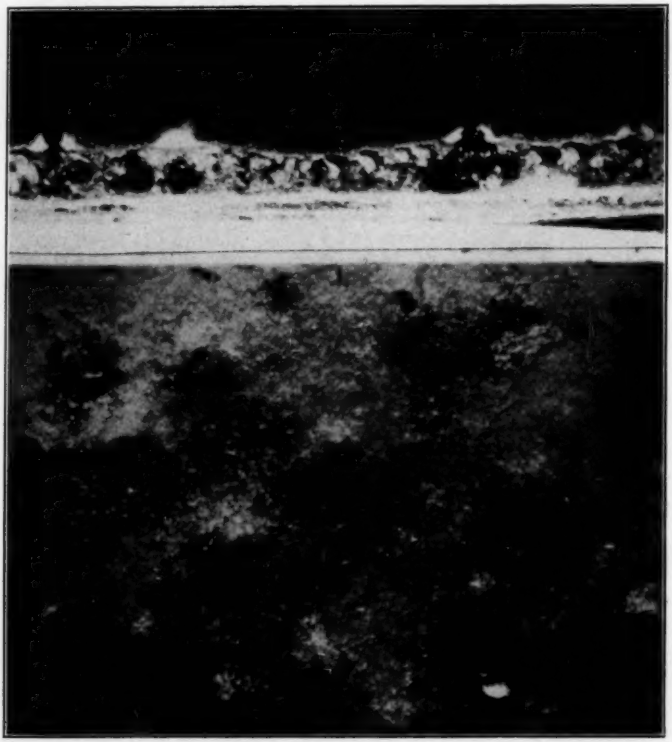


FIG. 2. *Melanconis apocrypta* Ellis: Radial section (above) and surface view (below) of perithecial stromata. (× 20)

with this *Melanconis* again demonstrates the errors arising from life history connections based on association alone.

MELANCONIS APOCRYPTA Ellis

Material of *Melanconis apocrypta* Ellis was collected on *Populus* sp., at Upper Brookside, near Truro, Nova Scotia, on July 9, 1935. It was found on a recent windfall and occurred as flat,

papillate, yellowish pustules (FIG. 2), 0.3–0.8 mm. in diameter and thickly scattered over wide areas of the twigs and limbs. These pustules are faintly outlined by a darkened zone and have a minute central erumpent disc containing the convergent erumpent ostioles. The ectostroma itself is white to yellowish, flattened hemispheric and with the perithecia circinnate beneath. The ascospores (FIG. 3: 7) are hyaline at first, then brown and 23–33 × 11–14 μ. As the ascus walls dissolve in water, the periplasm pinches off between the spores, often leaving a gelatinous envelope about the spores.

Ascospores from this material were sprayed onto Leonian's agar on October 23. No germination occurred during the first twenty-four hours, but after forty-eight hours a few spores were found germinating slowly. The spores swelled slightly, measuring 36 × 18–19 μ, and pushed out, usually, a single germ tube about 6.5 μ in diameter.

Growth on oatmeal agar was rather slow, a colony reaching a diameter of 1–1.5 cm.. in ten days. Early growth was barely visible to the eye as a pale red brown superficial mycelium which darkened with age becoming dark red-brown to black. In these blackened areas, portions of the hyphae swell to form large spherical or irregular chlamydospore-like cells (FIG. 3: 9) which may be either terminal or intercalary. The walls of these cells and adjacent hyphae become dark brown. The chlamydospore cells become filled with this pigment which diffuses into the surrounding agar forming a dark halo about them. In cultures two to three months of age, a cottony superficial growth of mycelium and a few small pulvinate stromata appeared. In some of these stromata, masses of one-celled brown conidia were formed. These conidia (FIG. 3: 8d) were irregular in shape, ovoid to ellipsoid-clavate, measured 15–28 × 6.5–10 μ and appeared to be abnormal in their development.

Growth on autoclaved twigs of *Populus deltoides* was also comparatively slow. In moist cultures a large amount of white cottony superficial growth occurred, but as the tubes dried out, or on those twigs transferred to large damp chambers, more normal immersed stromata were formed. The pale yellowish ectostromata were such as found in nature, but larger (1–4 mm. in diameter), and were

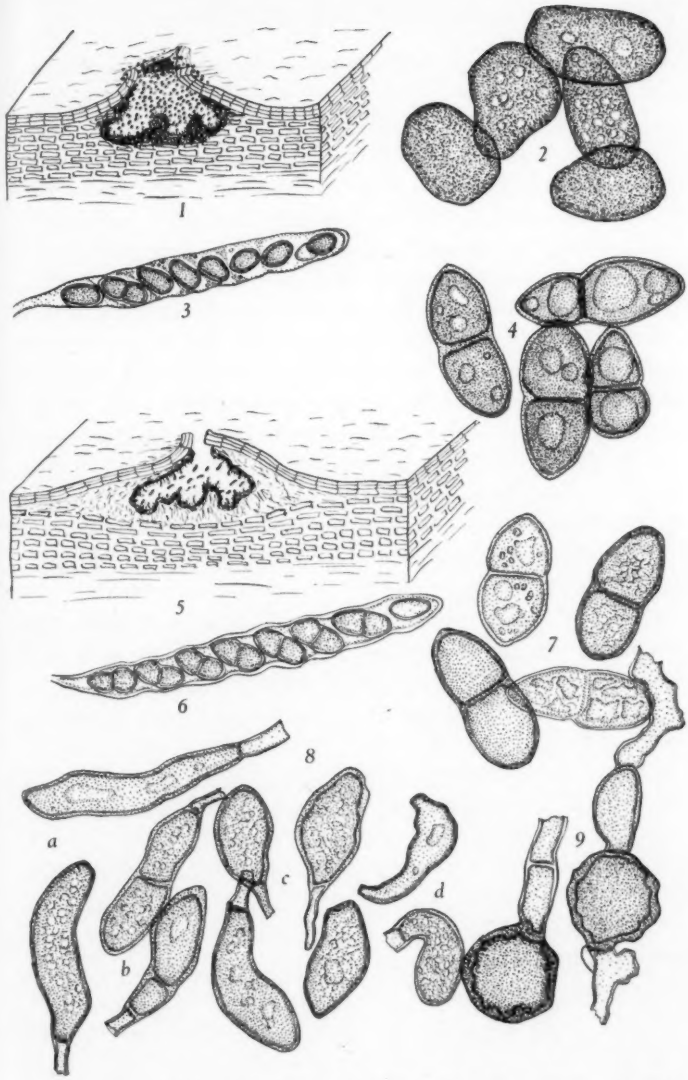


FIG. 3. 1–4 *Melanconis pallida* Rehm, 5–9 *Melanconis apocrypta* Peck: 1, vertical section of conidial stroma (*Melanconium intermedium* Peck); 2, conidia; 3, ascus containing both one-celled and two-celled ascospores; 4, ascospores; 5, vertical section of conidial stroma; 6, ascus with ascospores; 7, ascospores; 8, conidia: *a* elongate clavate, *b* two celled, *c* short ellipsoid forms produced on twig cultures, *d* irregular forms produced on agar cultures; 9, chlamydospore-like bodies formed in agar cultures.

composed of hyaline prosenchymatous hyphae, 1.5–4 μ in diameter. The conidial stromata (FIG. 3: 5) were up to 1 mm. in thickness and in these one or two fertile areas arose, outlined by a slightly differentiated, yellow-brown, wall-like zone. These locules were usually entirely enclosed, at least at first, and the conidia were formed as clavate outgrowths of the apex of thick conidiophore hyphae and were cut off by cross walls at various levels in the fruiting area so that a compact mass of spores rather than a clear-cut hymenium resulted. The conidia (FIG. 3: 8) were at first hyaline, but soon became yellow to olive-brown with a granular content. They were quite variable in size and shape being ovoid or fusoid-ellipsoid (FIG. 3: 8c) to elongate-clavate (FIG. 3: 8a), straight to variously bent or curved and often giving the impression of abnormality as in the case of the conidia formed on agar. They were mostly one-celled, but quite a few two-celled conidia (FIG. 3: 8b) could also be found. The ellipsoid spores measured 15–25 × 8.5–10 μ, whereas the elongate clavate forms ran 29–45 × 8.5–11.5 μ.

Perithecial primordia were sometimes observed beneath these stromata in an entostromatic development in the bark cortex but were much more abundant beneath other sterile ectostromata which were smaller and undoubtedly represented the immature discs of perithecial pustules.

Ellis (1, p. 194), in his original description of this species, suggests *Melanconium populinum* Peck as the imperfect stage. An examination of the type material of *M. populinum* (N. Y. State Mus. Herb. ex Ellis No. *3637*) reveals rather large angular pustulate ruptures caused by the growth of whitish ectostromata up to 1.5 mm. in diameter, which in turn contain large lobed cavities which are often entirely enclosed at first and resemble very closely those obtained in culture. The conidia of *M. populinum*, however, are oblong-ellipsoid and quite regular in shape, usually with a darkened basal scar at the point of attachment. These conidia are pale brown, becoming darker, one-celled, and 13–16.5 × 5.5–6.5 μ. It is possible that the conidia obtained in culture represent an abnormal condition of the conidia of *M. populinum*, but until there is further substantiation of this possibility it would

seem better not to apply this name to the conidial stage of *Melanconis apocrypta.*

The specific relationships of *Melanconis apocrypta* are not clear. It has the light colored ectostroma of the *Melanconis marginalis-M. Alni-M. stilbostoma* group but differs in the brown ascospores and conidia, the slight development of the ectostromatic disc, and the enclosed character of the conidial locules. These enclosed locules, together with the tendency for the conidia to become long clavate and two-celled suggest a transition toward the species with a Stilbospora conidial stage, as has been reported for *Melanconis thelebola. M. thelebola,* however, has light colored and appendaged spores. Further knowledge of conidial connections of other species may clear up these relationships.

PSEUDOVALSA STYLOSPORA Ellis & Ever.

Pseudovalsa stylospora is an interesting species occurring as numerous small pustulate ruptures (FIG. 4), 1–2 mm. in diameter, on the surface of maple limbs. The small white ectostromatic disc formed on the bark surface causes a radiate rupture of the periderm which may fall away in age. The perithecia arise in the unaltered or slightly entostromatic bark cortex beneath. The ostiolar necks penetrate through the small ectostroma and almost obliterate it, being erumpent as a small fascicle of short or slightly elongate ostioles. The asci lie free, in a mass, within the perithecium with a few evanescent bandlike paraphyses. When young, the asci are rather elongate-clavate, 80–85 × 14–15 μ and the spores are then biseriate, fusoid, one-celled and hyaline. The spores (FIG. 5: 2) soon become elongate, oblong-ellipsoid, three-celled and finally pale yellow-brown. The asci meanwhile become broad-clavate (FIG. 5: 4) or saclike with a thickened apex and measure 53–66 × 20–28 μ. The spores in these asci are massed together, are more or less constricted at the septa, commonly show a small caplike appendage at each end and are 22–40 × 9–12 μ.

The general appearance and stromatic configuration of this species suggests certain species of *Cryptodiaporthe* as *C. densissima* and *C. myinda,* also occurring on maple. The small but distinct, white ectostroma recalls *C. galericulata,* in which species the spores may also become brown at full maturity and which, it seems, has

been described under other names (*M. leucostroma*) in the genus *Melanconis*. The biseriate arrangement of the spores in the elongate young ascus is a condition commonly found in *Melanconis* and *Cryptodiaporthe*, whereas the massing of the spores in the saclike

FIG. 4. *Pseudovalsa stylospora* Ellis & Ever.: Radial section (left) and surface view (right) of perithecial stromata. (× 20)

mature ascus is commonly found in *Pseudovalsa*. The bearing of the conidial stage on these relationships will be considered later.

Sprays of ascospores of this species were first made on August 5, 1926, from twigs of *Acer spicatum* collected at Wolfville, Nova Scotia, the preceding June. A second isolation was made on October 10, 1934, from *Acer spicatum* collected at Seventh Lake, N. Y., the previous August. The results were similar in both

cases. Germination (FIG. 5: 3) occurred from twenty-four to forty-eight hours after the spores were sprayed onto agar. These spores were mostly hyaline, but some pale brown spores were seen germinating. A few spores which were still one-celled germinated. Only those spores with a granular content, and not those with a homogeneous protoplast, were able to germinate. The germinating spores measured 31–37 × 11–14 μ and put forth from one to four germ tubes, some five microns in diameter.

Growth was very slow on nutrient agar but more rapid on oatmeal agar. The advancing margins of the colonies were white, but soon turned grayish in the older portions. At the center of older cultures, numerous grayish pulvinate stromata, 1–2.5 mm. in diameter, appeared, from which pinkish to yellowish-brown masses of conidia were extruded. The center of these stromata contained a single chamber lined by the conidial hymenium. These conidia (FIG. 5: 5f) were oblong-ellipsoid to long-cylindric, straight or often slightly curved or bent at one end, one- to usually four-celled, hyaline and 17–44 × 5–6.5 μ.

In the case of both isolations, twigs of *Acer saccharum* were inoculated from single spore cultures and after two to three weeks small pustulate swellings appeared on these twigs. The spore horns from these pustules were grayish to yellow-brown when moist to almost black when dry.

The formation of the stromata on *Acer* (FIG. 5: 1) was instructive. The ectostroma arises on the surface of the bark cortex, just beneath the periderm as a thin layer, some 20 μ thick, composed of fine hyaline hyphae, and may extend for some distance. Where conidial locules arise, this tissue increases greatly in thickness and a cavity arises in the center as a result of spore formation from free hyphal tips in this region. The pycnidium may remain flattened or increase in thickness and become spherical. A definite wall of pseudoparenchyma cells with dark olive-brown walls is formed on the surface. This wall is more strongly developed below than above. As a result the periderm may at times be thrown back with the upper wall adhering to it and more or less exposing the spore bearing cavity. The conidia (FIG. 5: 5e) in these cavities were similar to those formed on agar but not so commonly bent at one end, more constantly four-celled and meas-

ured 33–50 × 5–6.5 μ. They are borne upon a hymenium of short stout cylindric conidiophores.

Entostromata were also strongly developed upon these twigs, but they always arose at a depth of two to three cell layers within the bark cortex and never produced pycnidia. They consisted of a proliferation of fine hyaline hyphae intermixed with the remains

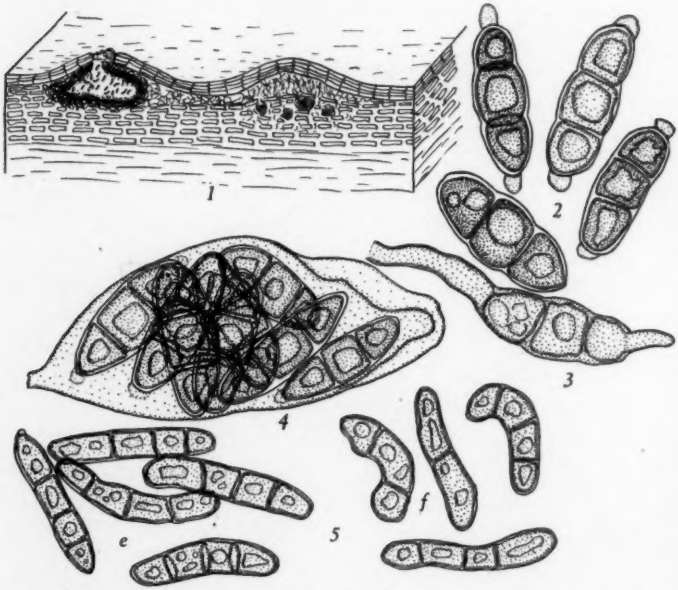


FIG. 5. *Pseudovalsa stylospora* Ellis & Ever.: 1, vertical section of conidial and young perithecial stromata; 2, ascospores; 3, germinating ascospore; 4, ascus with ascospores; 5, conidia: *e* as formed on twigs of *Acer saccharum* in culture, *f* as formed in agar cultures.

of bark cortex cells. Perithecial initials consisting of spherical knots of coiled hyphae were frequently found in these entostromata.

Ellis (2, p. 223), in his original description of this species, mentions "pycnidia central bearing 3-septate, hyaline stylospores, 40–55 × 10–12 μ on short basidia" which are undoubtedly the same as those obtained in culture, even though he gives the diameter as twice as great.

In the light of what has been said regarding the relationships of the perithecial stroma, this conidial stage is of interest. The conidia here are hyaline and formed within an enclosed locule, which is characteristic of *Diaporthe* and certain species of *Cryptodiaporthe,* rather than colored and on the surface of the stroma as is supposed to be the case in most species of *Melanconis* and *Pseudovalsa.* They are, however, many-septate as in *Pseudovalsa.* The genus *Pseudovalsa,* it is the writer's belief, will fall into several species groups in which the conidial stage will be correlated with certain ascospore characters. Conidial connections of certain species with caplike appendages, as *P. aucta* and *P. macrosperma* would be of interest in this respect. Tulasne (**6**, *pl. 14, fig. 13–23*), for instance, illustrates a somewhat similar pycnidial stage for the latter species but with dark colored, four-celled conidia. *P. stylospora* may represent a type intermediate between certain appendaged *Cryptodiaporthes* and certain brown spored species of *Pseudovalsa.*

UNIV. OF MICHIGAN,
ANN ARBOR, MICH.

LITERATURE CITED

1. **Ellis, J. B.** New species of North American fungi. Am. Nat. **17**: 192–196. 1883.
2. —— **& Everhart, B. M.** New North American fungi. Proc. Acad. Nat. Sci. **1890**: 219–249.
3. **Höhnel, F. von.** System der Diaportheen. Ber. Deut. Bot. Ges. **35**: 631–638. 1917.
4. **Peck, C. H.** Report of the Botanist (1876). N. Y. State Mus. Rep. **29**: 29–82. 1878.
5. **Rehm, H.** Ascomycetes novi. Ann. Myc. **10**: 387–397. 1912.
6. **Tulasne, L. R. & C.** Selecta Fungorum Carpologia **2**: 1–319. Paris. 1863.
7. **Wehmeyer, L. E.** Cultural life histories of *Melanconis* and *Pseudovalsa.* Mycologia **18**: 257–273. 1926.
8. **Winter, G.** Ascomyceten. *In* Rabenh. Krypt.-Fl. 1^2: 1–928. Leipzig. 1887.

RHIZOPUS ELEGANS EIDAM[1]

LEWIS B. LOCKWOOD

In 1820, Ehrenberg (**4**) established a new genus *Rhizopus,* based upon a fungus *R. nigricans,* which he had previously described as *Mucor stolonifer.* The new genus *Rhizopus* was characterized by the presence of stolons, which were lacking in *Mucor.* While it is not possible definitely to identify any species now known with *R. nigricans* Ehrenberg, usage has associated this name with a large achlamydosporic form with spheric or subspheric, collapsing columellae, rough sporangial walls, and angular, striate spores, 8–15 μ in diameter.

In 1886, Eidam (**5**) described a new species of *Rhizopus, R. elegans,* which has smooth rounded spores, but is similar to *R. nigricans* in most other characteristics. He made no reference to the apophysis, which is assumed to be lacking. Schostakowitsch (**13**) established the genus *Actinomucor,* based upon *A. repens* Schostak., for a stoloniferous *Mucor* in which the apophysis was also lacking. Lendner (**8**) described a *Mucor botryoides* Lendner in 1910. Reinhardt (**11**), after examining Lendner's culture, reported the presence of stolons in *M. botryoides.* He concluded that *R. elegans* Eidam and *A. repens* Schostak. were synonyms of *M. botryoides* Lendner, and retained the latter name. Bainier (**1**) in 1903 described *Glomerula repens.* Lendner (**7**) changed this to *Mucor glomerula* (Bainier) Lendner, while Saccardo (**12**) in 1912 called the organism *Mucor repens* (Bainier) Sacc. and Trot. Pišpek (**10**) in 1929 described *Mucor Cunninghamelloides,* from the soil of Jugoslavia. Harz (**6**) described in 1871 *M. corymbosus,* which Zycha (**15**) considered a questionable synonym of *Actinomucor repens.* Zycha (**15**) retained the name *Actinomucor repens,* and gave as synonyms *R. elegans* Eidam, *M. botryoides* Lendner, *Glomerula repens* Bainier, *Mucor glomerula* (Bainier)

[1] 263d Contribution from the Industrial Farm Products Research Division, Bureau of Chemistry and Soils, United States Department of Agriculture, Washington, D. C.

Lendner, and *Mucor Cunninghamelloides* Pišpek, and *M. corymbosus* Harz?. He considered *Actinomucor* to be transitional between *Mucor* and the Thamnidiaceae. The genus *Actinomucor* is monotypic.

The occurrence of stolons is deemed an adequate basis for rejection of the genus *Mucor* for this species. The problem of the systematic position of this species now resolves itself into the question of the value of the apophysis for separation of the two genera. The apophysis is a swelling at the base of the sporangium. Accordingly, counts of sporangia with and without apophyses were made. In *R. nigricans* Ehrenb. *747,* apophyses were lacking in 33.8 per cent of the sporangia; in *R. reflexus* Bainier *838,* apophyses were lacking in 21.1 per cent of the sporangia, and there were no apophyses beneath 9 per cent of the sporangia of *R. fusiformis* Dawson and Povah *916.* In *R. pygmaeus* Naumov, the apophysis is usually lacking, but *R. pygmaeus* is so close to *R. microsporus* van Tieghem that separation is difficult on other bases. Further, the writer has often observed sporangia of *R. liquefaciens* Yamazaki with which there were no apophyses.

Several cultures of *R. elegans* have been studied. In these cultures, the apophysis is uniformly lacking. The colony type and development of stolons is typical of that of the larger members of the genus *Rhizopus; i.e., R. nigricans* Ehrenb., *R. Oryzae* Went and Geerligs, and *R. reflexus* Bainier. Branching is characteristic of the center of the deep type of *Rhizopus* colony. Clusters of sporangiophores, which may be septate, arise from nodes opposite the rhizoids. Rhizoids may be poorly developed as in *R. arrhizus* Fischer, or with more extensive development as in *R. nigricans* Ehrenb. Branches of the sporangiophores arise irregularly, often suggestive of the manner of those of *M. racemosus* Fresenius, or verticillate as in *R. Artocarpi* Racib. This latter mode of branching has been described for *R. umbellatus* Smith (**14**), but Miss Smith's illustration and description are strongly suggestive of *Absidia.* It has been described for *R. nigricans* var. *verticillatus* Demelius (**2**). When the stolon does not come into contact with some solid substrate, there is irregular and slight development of rhizoids, and irregular development of sporangiophores. Sometimes in *R. elegans,* the stolon will terminate in a sporangium as in

R. reflexoides Philippov (**9**). In such cases, frequently the large sporangium at the end of the stolon will be subtended by a verticil of short branches bearing smaller sporangia. It is probably some structure such as this which caused Zycha to place *Actinomucor* intermediate between *Mucor* and the Thamnidiaceae.

While making a study of the physiology of the species of the genera *Mucor* and *Rhizopus*, it was found that *Mucor hiemalis* Wehmer *522, 545, 854; M. griseo-lilacinus 572, 625, 701, 749, 860; M. plumbeus* Bonorden *521; M. racemosus* Fresenius *505; M. zeicola* Graff *496; M. griseo-cyanus* Hagem *502, 506, 508; M. christianiensis* Hagem *526; M. genevensis* Lendner *548, 462, 563; M. coprophilus* Povah *588; M. javanicus* Wehmer *579, 718; M. circinelloides* van Tieghem *755, 840; M. geophilus* Oudemans *550; Mucor* sp. *568, 571,* and *582* readily utilized $NaNO_3$ as a source of nitrogen. *Rhizopus Artocarpi* Raciborski *640, 641, 881; R. bovinus* van Beyma *844; R. chinensis 492; R. Cohnii* Berlese and de Toni *871; R. delemar* (Boidin) Wehmer *395; R. elegans* Eidam *882, 883, 914; R. formosaensis* Nakazawa *843; R. fusiformis* Dawson and Povah *916; R. nigricans* Ehrenberg *491, 499, 520, 538, 611, 738, 747, 821; R. nodosus* Namyslowski *584, 585; R. Oryzae* Went and Geerligs *394, 610, 617, 649, 660, 664, 704, 713, 720, 723, 739, 743, 778; R. Peka I* Takeda *839; R. pusillus* Naumov *798; R. pygmaeus* Naumov *797; R. reflexus* Bainier *515, 796, 838; R. shanghaiensis* Yamazaki *913; R. suinus* Nielsen *795, 833; R. Tritici* Saito *488, 602, 654,* and *681* were unable to utilize $NaNO_3$ as a source of nitrogen. Bach (**2**) reported that *Rhizopus* was unable to utilize nitrate.

A number of times apparent late growth of *Rhizopus* occurred on $NaNO_3$ solutions, but in all such cases the cultures were found to be contaminated with *Absidia, Cunninghamella, Syncephalastrum,* or an Hyphomycete. When the cultures were purified, no growth occurred on $NaNO_3$. It is probable that the contaminating organism utilized the $NaNO_3$, and after autolysis had set in, the *Rhizopus* began to use the nitrogen from the autolyzing mycelia.

No species of *Rhizopus* studied was able to utilize $NaNO_3$ as a nitrogen source, while all species of *Mucor* studied utilized $NaNO_3$ readily. The writer has successfully utilized this in the elimina-

tion of *Rhizopus* from cultures of other fungi contaminated by *Rhizopus*.

Several *Rhizopus* cultures produced large quantities of lactic acid from glucose, while no *Mucor* gave apppreciable yields of lactic acid. Cultures of *R. elegans* were not able to utilize $NaNO_3$ as a sole source of nitrogen, but when $(NH_4)_2SO_4$ was supplied, culture No. 914 produced large quantities of lactic acid from glucose. While the last two points are of physiological nature, the writer is not inclined to offer them as basic points for use in delimiting genera and classifying species. However, it is believed that they indicate that the affinities of the organism in question are closer to *Rhizopus* than to *Mucor*.

In view of the fact that *R. elegans* has stolons, the deposition of the species in the genus *Mucor* is believed untenable. The maintenance of the genus *Actinomucor* separate from *Rhizopus* is believed undesirable because the basic character of absence of an apophysis is inadequate and unreliable. The name *Rhizopus elegans* Eidam should be maintained, the deposition of the species in the genus *Rhizopus* being based upon the morphology of the organism, supported by physiological experimentation as herein reported.

U. S. DEPT. OF AGRICULTURE,
WASHINGTON, D. C.

LITERATURE CITED

1. **Bainier, G.** Sur quelques espèces de Mucorinées nouvelles ou peu connues. Bull. Soc. Myc. Fr. **19**: 153. 1903.
2. **Bach, Denis.** Compt. Rend. Paris **184**: 1578–1579. 1927.
3. **Demelius, Paula.** Über einige neue Hyphomyceten und eine neue Varietät des *Rhizopus nigricans* Ehr. Verh. zool.-bot. Ges. Wien **64**: 489–494. 1916.
4. **Ehrenberg, C. F.** De Mycetogenesi. Nov. Act. Acad. Leop. **11**: 198. 1820.
5. **Eidam.** Jahres-Bericht der Schlesischen Gesellschaft für vaterländische Cultur **61**: 232. 1883.
6. **Harz, C. O.** Bull. Soc. Imp. Nat. Moscou 44. 1871.
7. **Lendner, Alf.** Les Mucorinées de la Suisse, Matér. Fl. Crypt. Suisse **3** (1): 1–177. 1908.
8. ——. Nouvelle contributions á la Flore Cryptogamique Suisse. Bull. Soc. Bot. Genéve II **2**: 78–81. 1910.
9. **Philippov, G. S.** Oplesnevyki gribkakh gruppy Mucorineae. Bolezni Rastenii (Morbi Plantarum) **15** (4): 175–186. 1926.

10. **Pišpek, P. A.** Edafske mukorineje Jugoslavije. Acta Bot. Inst. Bot. Univ. Zagrebensis **4**: 77–112. 1929.
11. **Reinhardt, M. O.** Mykologische Mitteilungen I. *Mucor botryoides* Lendner. Ber. Deut. Bot. Ges. **43**: 463–468. 1925.
12. **Saccardo, P. A.** Syll. Fung. **21**: 821. 1912.
13. **Schostakowitsch, W.** *Actinomucor repens* n. g. n. sp. Ber. Deut. Bot. Ges. **16**: 155–158. 1898.
14. **Smith, A. Lorraine.** Fungi found on farm seeds when tested for germination, with an account of two fungi new to Britain. Jour. Royal Micr. Soc. **1901**: 614–618. 1901.
15. **Zycha, H.** Kryptogamenflora der Mark Brandenburg, Pilze II, Mucorineae, 1–264. 1935.

A CRITICAL STUDY OF THE MYCETOZOA OF LONG ISLAND

ROBERT HAGELSTEIN

The Mycetozoa or Myxomycetes are an interesting group of organisms with a unique life history. Commencing their cycle with the spores, these, with suitable conditions of moisture and temperature, will germinate into small, amoeboid bodies—true animals—which, after various transformations, fuse in great numbers to form a living slime called the plasmodium. The plasmodium moves by extending pseudopodia, feeds, and increases in size by nuclear division. It is generally admitted to be an animal. When the time comes for reproduction, the plasmodium emerges from its habitat, draws itself together, and forms fruiting bodies or spore carriers, the spores of which repeat the cycle. The fruiting bodies and spores are similar in appearance and certain physiological characters to those of the fungi. The classification of the group is based upon them as there is no differentiation in the plasmodia except size, color, and habitat. The study of the forms is confined mainly to botanists, although their position as vegetable is not established, and their earlier life history indicates a closer relationship to the animals.

It is not possible within the confines of this paper to give a complete story of the life history, morphology, physiology, and taxonomy of the Mycetozoa. For this, the reader is referred to the two excellent monographs on the subject, mentioned in the footnote,[1] which should be in the library of every nature student. They are complete, and nothing further is required, but they are necessary for a proper understanding of this paper, as the interpretations of species are based upon the descriptions in those monographs, and frequent references are made thereto.

[1] Lister, G. A Monograph of the Mycetozoa, ed. 3, xxxii, 296 p., 222 col. pl. London, British Museum, 1925. Sh. 31/6. Macbride, T. H. and Martin, G. W. The Myxomycetes, viii, 339 p., 21 pl. New York, Macmillan Co., 1934. $6.00.

The plasmodia of the Mycetozoa inhabit decaying, vegetable material. Broadly, they may be divided into two divisions; those that live, move, feed, and grow in and on wood, logs, dead trees, etc.; and those that thrive in and on the substratum of the soil. While some species favor both habitats, the great majority are confined to one, developing their fructification on their particular habitat, and usually in close proximity to where the plasmodium emerges. There are instances where the plasmodia travel for some distance before fruiting, apparently seeking dryer places to insure perfect maturity. Our field experience indicates that where this travel is for any long distance, the food supply has been exhausted in the original habitat, and the plasmodium seeking another base and finding none, is compelled to go into fruit, to avoid desiccation and destruction. Some of the species have a preference for particular wood or leaves, but this is not general, and usually the plasmodia adapt themselves to any material available for their group, wood or the ground.

Fructification occurs when the plasmodia reach a certain size, varying with the species, and requiring a definite length of time. When this is known, the appearance may be looked for in appropriate periods or months of the season. Many species have a short period, appearing therefore several times in a season. Others fruit only once in the late season, the plasmodia vegetating through the spring and summer months. There are a few species that appear only at intervals of years, and it is probable that there the plasmodia do not transform into fruit annually. It is also known, that with the entire absence of food the plasmodia must go into fruit. With the advent of frosts and colder weather, in the late fall, the plasmodia form into hard, sclerotioid, masses, by which they survive the winter, and are revived by the warm weather and rains of early spring.

The Mycetozoa comprise about three hundred and fifty recognized species, arranged in about sixty genera. The classification is based on the varying characters of the fruiting bodies known as sporangia, plasmodiocarps and aethalia. The sporangial fructification is the most common, with sporangia of small, microscopic size, while aethalia may be six inches, or more, across. The fruiting bodies exhibit great diversity in shape and color, and of more

importance are the differences in capillitium, spores, stalks when present, and the absence or presence of lime. Many of the species have a wide range of variation, caused perhaps by differing conditions at the time of fructification as well as during the plasmodial stage. There are numerous forms intermediate between species, yet the main specific characters are very constant, and found in specimens from all parts of the world. There is an almost unbroken line of forms, merging one into the other, throughout the entire series of genera and species. It is evident that the Mycetozoa are a very young group, expressed in geologic age, and that insufficient time has passed to permit any semblance of sharp demarkation, even between genera that are sharply defined at the extremes. The evidence in favor of hybridism is neither conclusive nor disproved. Hybrids probably exist, and further study through culture methods, may show that several forms, at present regarded as species, may be hybrids; particularly so, those few that appear only after long intervals.

The fruiting bodies may be found from April to December, and sometimes later if the winter is mild, on suitable habitats with proper conditions for their development. A moist, marshy, area, well forested, and with sufficient fallen and decaying timber, makes a happy hunting ground. They may be searched for in parks, woods, back yards, or even at the seashore. Piles of lumber, straw, hay, manure, and tree trimmings, often yield many interesting species. Wherever vegetable material is in early stages of decay, they may be found; but the value declines with the decrease of the bacteria on which the plasmodia depend for food. Situations directly exposed to the heat and light of the sun, are not suitable, as there is insufficient moisture. The Mycetozoa are so beautiful, their collection so easy, and their preparation so simple, that in this age of nature study enthusiasm, more persons should avail themselves of the opportunity they offer. It is hoped that among the readers of this paper, there will be more who will undertake their study.

In the collection and study of the Mycetozoa, the best results are achieved by confining activities to a prescribed region, with intensive work there, rather than desultory collecting here and there at widely separate localities. In that way the student ac-

quires knowledge of the forms in the region, at first hand, and with the material for study in all its phases and variations, is in a better position to judge the extensions or limitations of a species. Variation is so great, that often, a number of collections must be made before a determination of the species is possible. One of them will have the salient character on which the species is based. Also, it is the variation that makes the study so fascinating.

About twelve years ago, I commenced their survey in Long Island, and have been actively assisted therein by Mr. Joseph H. Rispaud, and to some extent by two other friends, Mr. Leon J. Chabot and Mr. John D. Thomas, so that whenever the plural pronoun is used in this paper, it means that more than one of us were engaged in the collection or observation. Long Island is situated at the southeastern end of the State of New York, a part thereof, and has many natural advantages for the development of the Mycetozoa. There are many wooded kettle holes in the terminal moraine traversing the Island. The large estates, with their piles of rotting timber, that has been cut out to beautify the landscape, the forested swamps adjoining the many brooks and waterways, and the lumber yards are fertile localities. The latter, brought about by the extensive building operations in recent years, receive lumber from different parts of the world, and this often carries spores and plasmodia, some of which adapt themselves to the new environment. I do not believe, however, that the conditions here are better than elsewhere, but that the satisfactory collecting results were obtained by the intensive efforts made over a long period. During a recent visit to the Adirondack Mountains of New York State, Mr. Rispaud and I collected more than seventy-five species in four days, within a limited area. This is about the number of species that may be collected, anywhere, in a season, and were found in our first year on Long Island. The next year, yielded about the same number, certain species replacing others that were not found again. Thus it continued, year after year, the number of new collections gradually becoming smaller, so that now we are happy if we find, in a season, one or two species that we have not seen before. Of the 162 species reported in this paper, all but two or three were found in the area of Nassau County, where our most active work was

done, but the great majority were also collected in other parts of Long Island. There are still many forms that have been collected in adjacent territory, but not seen here, and it is a fair guess, that eventually two hundred species will be reported from Long Island. The work will be continued.

We are methodical in our field explorations. Driving over the beautiful roads of the Island, we are continually on the watch for auspicious spots or small units. If any are seen, they are examined for signs, and if found, the place is visited again. If the locality comes up to our expectations, it is visited repeatedly, particularly within a few days after a rainy spell, when the fruiting bodies appear abundantly in a rich spot. It is in this way that we have discovered a few areas, which are very productive, and most of our time has been spent in them with better opportunities for making extensive collections. In each of these places, one or more species have been found that have not been observed elsewhere, and also, at many other situations, rare or unusual forms have been found under less favorable natural conditions. These are visited occasionally, and at such times, when our records show that the expected form is about due to appear.

Albertson, mentioned frequently in this paper, has been, and is yet, our best, small, collecting unit. The name, for our purposes, applies to a kettle hole in the foothills of the moraine, on the I. U. Willets road, about three-quarters of a mile west from its intersection with Willis avenue, in the Village of Albertson. It is south of the road and adjoins it, directly opposite an entrance of the Shelter Rock Country Club. The ground comprises about four acres, sloping gradually to a depth of about thirty feet below the surrounding, irregularly circular, crest. The bottom is always moist, except in times of drought, but water does not accumulate, as the thin, underlying, clay layer permits constant seepage. There is no brook water flowing into the depression, but it is evident that before the construction of the road, the area of the kettle hole was larger, and water from a nearby brook may have entered it. The area is heavily forested, with fallen, decaying timber, and much underbrush. It is unoccupied, and in a wild, natural, state.

I have described the area in detail, as it is ideal for the development of the Mycetozoa, having produced one hundred and eighteen

different species during the time of our investigations, of which three have been described as new to science. It is not unusual to find from twenty-five to thirty species fruiting at one time, some of them in abundance. The ground and wood of the whole area seem to be saturated with plasmodia, the different species following successively in their fruiting as the season advances. In one year, sixteen species were taken from the same log at various periods. The immediate surrounding territory is also good, and many species have been collected within a half-mile of the hole.

The railroad trestle, close to the station at Mill Neck, crosses a swamp on both sides of a brook, which comes from the lakes on the Brokaw estate to the south. The swamp extends along the road, for a half-mile or so, and is densely covered with old trees. There are many springs, with water bubbling from the ground, which keeps the whole region wet so that hip boots are required in some parts. It was our first extensive collecting ground, and in the early years, the best, with its wild, jungle-like, conditions. We have taken from there a total of eighty-eight species, among which was *Physarum penetrale*—our only collection. There might have been more, but a few years ago the present owner started to improve the place by cutting out decaying trees, removing them and the fallen trees and underbrush, filling in wet spots, and constructing rustic bridges over the rivulets that flow into the brook. It is all very nice and comfortable, but the usefulness to us is gone. We rarely visit it now, as the remaining species are those that are common everywhere, and the old nooks and crannies, that we were wont to search with glee, are also gone.

We reside in the Village of Mineola—all of us. On the usual habitats, in back yards, unoccupied ground, or the village streets, we have found fifty-three species, four of which have not been collected elsewhere. My back yard, measuring forty by fifty feet, has produced twenty species. Truly, it may be said, that we do not know what surrounds us until we look.

In 1927, I purchased a summer cottage at Jones Beach. Immediately on occupancy, we searched the vicinity of the cottage and found many species, on sedges and grasses close to the sand, on drift wood, under bayberry bushes, and on all sorts of rubbish strewn over the beach. Fruitings of *Lycogala epidendrum* were

found on several occasions, directly on the white sand, the plasmodia arising from newspapers buried in the sand. In a number of species, the best developments have been found on this beach.

The Meadow Brook locality is the marshy ground along the wooded brook of that name, east of the Village of Roosevelt, and extending several miles. The area is now included in Meadow Brook State Park. The natural conditions there are good, and more species will be collected in time, if the improvements in progress do not destroy the habitats. *Lamproderma columbinum* occurs there, usually in abundance on mossy stumps, in the late fall.

The name Great Neck is applied to the large kettle hole at the end of the Great Neck peninsula, a stretch of land jutting into Long Island Sound, with bays on each side. The hole is deep, perhaps fifty feet, heavily forested, and with much undergrowth. At the bottom is a pool of stagnant water, and altogether the place looks uninviting. Nevertheless it is rich in Mycetozoa, and we have explored it many times, using a hunting knife to cut our way through the thickets. It is the only place on Long Island, so far as we know, where specimens of *Brefeldia maxima* may be obtained at the appropriate fruiting time.

The Deer Park forest extends for several miles on each side of the Motor Parkway, commencing about two miles from the Deer Park road. It is a beautiful forest, with many trees that are two hundred years old, or more. The forest extends far enough away from the parkway, on one side, to obliterate all noises from passing automobiles, so that it is safer to carry a compass on a cloudy day, to assure rapid return to the car, as the trails are far apart. It is the home of deer and fox, and in the fall, the *Trichiae* are abundant and reach a better state of perfection than in wetter situations. Many other species are found throughout the season, but the developments are far apart and require much tramping in order to locate them.

The foregoing completes mention of our principal units. There are many of lesser importance to us, and others at points remote from our homes are under investigation, and indicate prospects of becoming satisfactory. It is to them that we are turning, as the old localities are nearing exhaustion, except for the forms that appear year after year.

In the field, each collector has a pocket knife with large, sharp, blade, and a hand lens. In the car, we carry a saw, chisel, and mallet for refractory wood, or fruitings across the grain, at the ends, which cannot be removed satisfactorily with a knife. The collected specimens are placed in old cigar boxes, the bottoms of which are lined with corrugated cardboard, and pinned thereon by pins with large glass or porcelain heads, which are more comfortable than those with the smaller, metallic heads. The boxes provide safe carriage, and the bottom cardboard absorbs much of the moisture on the way home. Great care should be taken to keep all pieces of one fruiting together, and not confuse them with others. Perfectly matured material should be sought for, but this is not always available in the case of rare or unusual species, and the beginner will require a little experience to know when material is well matured, or not too far gone. It is always best to leave some of the fruiting, if of a rare or unusual species, to avoid extinction in the neighborhood. Attention may be called here to the statement, often made, that certain forms are rare generally, which is not so with many of them that we have found repeatedly. They may be rare in a particular region, but over a large territory, the infrequency of collection is more apt to be due to unfamiliarity with the form or habitat, or because of absence during the limited periods in which some species appear.

On arrival home, the specimens should be prepared at once for drying. The wet, superfluous wood and leaves should be trimmed away, and the specimens placed in large, cardboard boxes, with a quantity of the ordinary napthaline flakes used for destroying moths and insects, care being taken to keep all fruitings separated. The boxes should be marked with the date of collection and locality, and then put away so that the material will dry out thoroughly, which may take a week or two. Conveniently thereafter, the specimens should be trimmed again, and permanently mounted in small cardboard boxes by affixing them with glue to the bottom or cover of the box, or to small pieces of cardboard with two sides turned up, which fit into the boxes and permit easy removal, if desired. Boxes, covers, and inserted cardboard should bear similar numbers so that the parts can be reconciled. It is best to assign a separate number to each fruiting, and to carry that num-

ber on all boxes and parts containing pieces of the fruiting. A neat method of storing in uniformly sized boxes, with suitable provision for duplicate material, will go far to make the entire collection more attractive in appearance. The specimens will keep well in small boxes without further attention, but larger boxes should be examined about once a year, and a small quantity of napthaline placed therein. Specimens should always be stored in covered boxes, and never so that that they are exposed to daylight for long periods, as they fade or change in color.

For the study of external characters, the specimens are examined, under a low power, in the boxes as mounted. For the capillitium and spores, all that is necessary is to place a little of both on a slide, with some water and a cover glass. It is difficult to remove air from the capillitium, and a weak solution of alcohol is sometimes preferable. For various methods, and also for the technique of making permanent mounts, the reader is referred to the Monographs previously mentioned. The method of examination in water is convenient, the spores swell rapidly, and the material is not altered in color or otherwise.

The student, in making determinations of species by transmitted light with the microscope, is advised not to attach too much importance to fine distinctions in spore color as given in the books, as the spores vary in color, in many species, in collections from the same locality. Also, color interpretations by different authors do not agree, depending evidently upon the human eye that made them, the lenses and lighting of the microscope used, and the medium in which the spores were mounted. In spores of the same species, larger ones will be darker than smaller ones, because the light passes through a greater thickness. Spore size also differs much from sizes given in the books, and the words warted and spinulose, as applied to spore sculpture, are often used synonymously. Such characters must be judged in relation to other characters that may be present, or in relation to those of the nearest related species.

The entire Long Island collections are considered a part of the Herbarium of The New York Botanical Garden, although remaining in my temporary custody for further study and comparisons. There is much duplicate material which is available to students in exchange for other specimens, properly matured, mounted,

and named. I shall be glad to extend aid and advice to others who may take up the study, and to determine forms that are sent to me properly mounted in the manner described. Each specimen should be glued into a separate, small, box, carrying the place and date of collection, and the habitat, if possible. There should also be a number, that corresponds to a similar number affixed to the part of the material retained by the correspondent, as the specimen will not be returned, and the determination will be made by number. The specimen sent should be of sufficient size, a square inch or so, to permit proper examination.

My thanks are due to Miss G. Lister and Dr. W. C. Sturgis, for the aid extended on many occasions in the determination of obscure specimens. The late Prof. T. H. Macbride, and the late Mr. Hugo Bilgram have also helped me greatly through correspondence. I recall with gratitude that the late Mr. Harold Wingate, many years ago, induced me to follow the study which has been a source of much pleasure during spare hours.

In the next few pages, I have arranged, alphabetically, all species found on Long Island, together with the principal stations where they have been collected. The list is of little interest to the distant reader. To the increasing number of students among the large population of New York City and its environs, it is of value as indicating definite localities where certain species may be found at appropriate times. A visit to the localities, more fully described in earlier pages, will do much to awaken an interest, which will become greater with observations under natural conditions, and the assurances that prolific developments will be found.

The species notes follow in alphabetical order, as there is no necessity for classifying them otherwise.

1. Albertson
2. Mill Neck
3. Mineola
4. Jones Beach
5. Meadow Brook
6. Great Neck
7. Deer Park
8. Various

	1	2	3	4	5	6	7	8
Amaurochaete fuliginosa (Sow.) Macbr.								*
Arcyria carnea G. Lister	*							
cinerea (Bull.) Pers.	*	*	*	*	*	*	*	*
denudata (L.) Wettst.	*	*	*	*	*	*	*	*
ferruginea Sauter	*							*
incarnata Pers.	*	*	*			*	*	*
insignis Kalch. & Cooke	*	*	*	*				*
magna Rex	*							*
nutans (Bull.) Grev.	*	*	*	*		*		*
occidentalis (Macbr.) Lister	*							
Oerstedtii Rost.	*					*		
pomiformis (Leers) Rost.	*	*	*	*		*	*	*
stipata (Schw.) Lister	*	*	*			*	*	*
Badhamia affinis Rost.			*					
decipiens (Curtis) Berk.					*			
foliicola Lister			*	*				*
gracilis Macbr.								*
lilacina (Fries) Rost.		*			*			
magna Peck								*
orbiculata Rex			*					*
panicea (Fries) Rost.	*	*						
papaveracea Berk. & Rav.			*					
rubiginosa (Chev.) Rost.		*					*	
utricularis (Bull.) Berk.			*					
Brefeldia maxima (Fries) Rost.						*		
Ceratiomyxa fruticulosa (Muell.) Macbr.	*	*	*	*	*	*	*	*
Cienkowskia reticulata (Alb. & Schw.) Rost.			*					
Clastoderma Debaryanum Blytt	*	*			*			*
Comatricha elegans (Racib.) Lister	*	*	*	*	*			*
extendens Hagelstein								*
irregularis Rex		*				*		
laxa Rost.	*	*		*				*
longa Peck	*				*			*
lurida Lister	*							
nigra (Pers.) Schröt.	*	*	*	*	*			*
pulchella (Bab.) Rost.	*			*		*		
Rispaudii Hagelstein	*							
rubens Lister	*					*		
subcaespitosa Peck	*	*			*	*		*
typhoides (Bull.) Rost.	*	*		*	*		*	*
Craterium aureum (Schum.) Rost.	*	*						
concinnum Rex	*							
cylindricum Massee		*	*			*		
leucocephalum (Pers.) Ditmar				*	*	*		*
minutum (Leers) Fries	*	*				*		*

	1	2	3	4	5	6	7	8
Cribraria argillacea Pers.				*				*
dictydioides Cooke & Balf.	*	*	*	*	*		*	*
intricata Schrad.	*	*		*			*	*
laxa Hagelstein	*							
macrocarpa Schrad.							*	
microcarpa (Schrad.) Pers.	*	*	*	*	*			*
minutissima Schw.				*				
piriformis Schrad.								*
tenella Schrad.	*	*		*				*
vulgaris Schrad.	*	*		*	*		*	*
Diachea leucopodia (Bull.) Rost	*	*				*		*
Dictydiaethalium plumbeum (Schum.) Rost	*	*						*
Dictydium cancellatum (Batsch) Macbr.	*	*	*	*	*		*	*
Diderma effusum (Schw.) Morgan	*	*	*	*	*	*		*
floriforme (Bull.) Pers.	*						*	
hemisphaericum (Bull.) Hornem.	*	*	*		*	*		*
montanum Meylan					*			
radiatum (L.) Morgan	*	*		*				*
simplex (Schröt.) Lister	*	*		*	*	*		*
spumarioides Fries	*	*			*			
testaceum (Schrad.) Pers.	*	*						*
Didymium anellus Morgan	*		*	*				*
Clavus (Alb. & Schw.) Rab.	*		*	*				*
difforme (Pers.) Duby	*	*	*		*			*
eximium Peck		*						
minus Morgan	*	*						*
nigripes (Link) Fries	*							*
ochroideum G. Lister	*							
squamulosum (Alb. & Schw.) Fries	*	*	*	*	*	*		*
xanthopus (Ditmar) Fries	*	*	*		*	*		*
Enerthenema Berkeleyanum Rost.			*					*
papillatum (Pers.) Rost.	*	*	*	*		*		
Enteridium olivaceum Ehrenb.	*	*	*					*
Rozeanum Wingate	*	*					*	*
Fuligo cinerea (Schw.) Morgan	*		*					*
septica (L.) Weber	*	*	*	*	*	*	*	*
Hemitrichia clavata (Pers.) Rost.	*	*	*	*		*	*	*
intorta Lister							*	
Serpula (Scop.) Rost.	*	*	*	*	*		*	*
stipitata (Massee) Macbr.	*	*					*	*
vesparium (Batsch) Macbr.	*	*		*		*	*	*
Lachnobolus congestus (Somm.) Lister			*					*
Lamproderma arcyrionema Rost.	*				*			*
columbinum (Pers.) Rost.	*	*			*			*
scintillans (Berk. & Br.) Morgan	*		*	*				
violaceum (Fries) Rost.		*						

	1	2	3	4	5	6	7	8
Leocarpus fragilis (Dickson) Rost.	*	*				*		*
Licea biforis Morgan		*			*			*
Lindbladia effusa (Ehrenb.) Rost.	*			*				
Lycogala epidendrum (L.) Fries	*	*	*	*			*	*
exiguum Morgan		*					*	*
flavofuscum (Ehrenb.) Rost.	*				*	*		*
Mucilago spongiosa (Leyss.) Morgan	*							
Oligonema flavidum Peck	*	*				*		
nitens (Lib.) Rost.	*		*	*				*
Perichaena chrysosperma (Currey) Lister	*		*		*	*		*
corticalis (Batsch) Rost.	*	*	*		*			*
depressa Libert	*		*			*	*	*
vermicularis (Schw.) Rost.		*	*	*				*
Physarella oblonga (Berk. & Curt.) Morgan	*		*			*		*
Physarum bogoriense Racib.				*				
cinereum (Batsch) Pers.	*	*	*	*	*	*		*
citrinum Schum.	*					*		
compressum Alb. & Schw.	*			*				*
confertum Macbr.	*				*			*
didermoides (Ach.) Rost.	*		*					*
flavicomum Berk.	*			*				*
galbeum Wingate	*	*		*	*			*
globuliferum (Bull.) Pers.	*	*	*		*	*		*
gyrosum Rost.			*					*
lateritium (Berk. & Rav.) Morgan	*						*	*
melleum (Berk. & Br.) Massee	*		*	*		*		*
murinum Lister	*	*				*	*	*
notabile Macbr.		*					*	*
nucleatum Rex	*	*			*	*		*
nutans Pers.		*	*	*				*
oblatum Macbr.		*		*				
penetrale Rex		*						
Physarum polycephalum Schw.	*					*		
pulcherrimum Berk. & Rav.								*
pusillum (Berk. & Curt.) Lister	*	*	*	*				*
rubiginosum Fries								*
sinuosum (Bull.) Weinm.	*	*			*	*		*
tenerum Rex	*	*				*		*
variabile Rex								*
virescens Ditmar	*				*			*
viride (Bull.) Pers.	*	*	*	*	*	*	*	*
Reticularia Lycoperdon Bull.	*	*						*
Stemonitis axifera (Bull.) Macbr.	*	*					*	*
carolinensis Macbr.	*							
confluens Cooke & Ellis			*					*
fenestrata Macbr.	*							*

	1	2	3	4	5	6	7	8
flavogenita Jahn	*							
fusca Roth	*	*	*			*		*
herbatica Peck	*			*	*			*
hyperopta Meylan	*	*						*
pallida Wingate	*	*						
Smithii Macbr.	*	*		*	*	*		*
splendens Rost.	*	*				*		*
trechispora Macbr.	*	*						*
virginiensis Rex	*							
Webberi Rex				*				
Trichia affinis de Bary	*	*				*	*	*
alpina (R. E. Fries) Meylan								*
Botrytis (Gmel.) Pers.	*				*		*	
contorta (Ditmar) Rost.	*							
decipiens (Pers.) Macbr.	*	*						*
favoginea (Batsch) Pers.	*						*	
floriformis (Schw.) G. Lister	*	*						*
inconspicua Rost.		*				*		*
persimilis Karst.	*	*		*			*	*
pulchella Rex	*	*				*	*	*
scabra Rost.	*	*				*	*	*
varia Pers.	*	*		*		*	*	
Tubifera Casparyi (Rost.) Macbr.							*	*
ferruginosa (Batsch) Gmelin	*	*		*		*	*	*
stipitata (Berk. & Rav.) Macbr.	*	*						

1. AMAUROCHAETE Rost.

The genus is closely related to *Stemonitis* and *Comatricha* as the irregular columellae and capillitium bear a resemblance thereto. The fructification is in aethalia, not in sporangia; the capillitium more or less netted; and the spores in all but one species, are large and dark in color. In *Stemonitis trechispora* Macbr., there are irregular forms that approach *Amaurochaete*.

1. AMAUROCHAETE FULIGINOSA (Sow.) Macbr. A single collection of this slime mold was made at the estate of A. G. Hodenpyl, near Locust Valley, in September, on cut, piled, timber, and is quite typical. The aethalium is irregularly circular, about 2.5 cm. in diameter, and the spores, generally are 12 μ, but frequently larger.

2. ARCYRIA Wiggers

The sporangia are stalked, with a well developed cup, and a capillitium consisting of a more or less elastic network of threads, variously ornamented, but not with distinct spirals as in *Hemi-*

trichia. The colors of the species represented on Long Island are shades of red, yellow, white or gray. In the separation of species, the capillitial markings and spore size are of secondary importance to the characters of shape, color, stalk, cup, and manner of attachment of the capillitium to the cup, except in *A. ferruginea* where the spores are larger than in other species of the genus. In all species, including the white ones, there is a tendency to change to a yellow color on long exposure to daylight.

1. ARCYRIA CARNEA G. Lister. A study of the original description and figures of Miss Lister in the Journal of Botany will give a better idea of the characters and affinities of this species than the description in the Monograph.

The species has been found a number of times on Long Island, always on stumps or logs in July and August, and much earlier than the fruiting period here of *Arcyria insignis.* It has the color, cup, and short stalk of the latter species, but the sporangia are larger and the habit is different. The fruitings are small, consisting rarely of more than three or four closely compacted clusters of sporangia, and the clusters are much larger, usually from 10 to 20 mm. across. The sculpturing of the capillitium is more pronounced, appearing as stout protuberances with blunt or truncate ends. In typical examples, the capillitium is attached to the cup at many points, but there are other collections, otherwise similar, where it is lightly attached and these are close to *Arcyria incarnata.* The species appears to be intermediate between *A. insignis* and *A. incarnata,* but is undoubtedly near to pink or flesh colored forms of the last named, and may be an irregular phase thereof.

2. ARCYRIA CINEREA (Bull.) Pers. Abundant throughout the season from June to October. Distinctly yellow forms are common, but not significant, because of the tendency to change in color by exposure to daylight. Pink forms are also found occasionally. There is much variation in the shape of the sporangia, and collections on grasses at Jones Beach, with minute, globose or ovoid sporangia, may, with more reason, be placed with *Arcyria pomiformis.* The capillitiums, however, are close and dense as in *A. cinerea.*

Var. DIGITATA (Schw.) G. Lister is not so common but has been found in large and beautiful developments in the Albertson kettle

hole, and also at various other places. In all instances, the partly coalescent stipes retain their identity, and in many the separation at the base is widely divergent. In some clusters, the stipes bend closely together at the middle, without joining, and with intermediate stages of approach. I have a specimen from Trinidad, B. W. I., where the stipes are completely merged into a heavy stalk and another, imperfectly matured, from the Adirondacks, where typical *A. cinerea* and var. *digitata* are developing from the same plasmodium. All these phases, in my opinion, cannot be regarded as more than varietal, although a species may be in the making. They may be dependent upon conditions prevailing at the time of fructification.

3. ARCYRIA DENUDATA (L.) Wettst. Abundant here as it is almost everywhere. It is readily recognized by its red color, large size, long and dark stalk, and the firm attachment of the capillitium to the cup.

4. ARCYRIA FERRUGINEA Sauter. The species occurs on Long Island in two distinct phases. The first was collected in May and October of the same season, in the Albertson kettle hole, and agrees with English specimens that I have. The sporangia are large, 2–2.5 mm. in total height, with a very elastic, expanding capillitium, so that when fully expanded the height may reach 3 mm. The color is red with a tinge of brown. The threads of the capillitium are 5–6 μ in breadth, varying little from the basal threads which are not unusually long. The spores are 9.5–10 μ in diameter. It appears to be typical *A. ferruginea.*

The other phase is entirely different in appearance. The sporangia are small, 0.08–1.4 mm. in total height. The capillitium is compact, non-expanding, with closely spinulose, flattened, threads, 5–8 μ in breadth, and attached to the cup by one or two extremely long basal or connecting threads. These threads are frequently as long as 10 mm., but much narrower than the upper ones, 2.5–3.5 μ. The spores are larger than in the other phase, 10.5–11.5 μ. Otherwise, there are no important differences in the capillitium, spores, or cup. We have observed one fruiting of this phase, in the field, from the emergence of the pink colored plasmodium to complete maturity, which required six days. At first brownish-red, the color changes finally to yellow throughout the entire spo-

rangium, from stalk to spores. We were obliged to remove the fruiting, with impending rain, so that the process was not complete in all sporangia. The color of the remaining sporangia has not changed since removal, although exposed to direct sunlight for several days.

This form has now been found six times on Long Island, at widely separated places in different years; and we have also found it recently in the Adirondack Mountains. All of the collections are similar, varying insufficiently to differentiate between them. In some, the free ends of the capillitium are more numerous and in others, the reticulation of the capillitium is more pronounced. I regard all as *Heterotrichia Gabriellae* Massee, allowing for possible errors in description, or particular emphasis that Massee may have laid upon inconstant characters. The spore size as given by Massee is 7–8 μ. Miss Lister records it as 10–11 μ after examining the type specimen. Our forms from Long Island, perfectly mature and constant, are sharply different from typical *A. ferruginea,* but are unquestionably *Arcyria.* If time should reconcile them with the South Carolina form of Massee, all may well be regarded as examples of a distinct species, *Arcyria Gabriellae,* rather than a variety of *A. ferruginea.*

5. ARCYRIA INCARNATA Pers. Far more abundant than *A. ferruginea,* and found at every important station where we have collected. It is very variable in capillitium, cup, spores, stalk, and color; and there are many intermediate forms approaching *A. ferruginea* or *A. denudata.* Two collections from Mineola have spores 9–9.5 μ in diameter, others are 8–9 μ. In several collections the capillitium is more firmly attached, like in *A. denudata,* but the color and other characters are more like those of local *A. incarnata.* A peculiar specimen from the Deer Park forest has free elaters instead of the usual capillitial net. The elaters are long or short, frequently terminating at both ends with bulbous thickenings and blunt points, the latter occasionally bifurcate. It developed, probably, under adverse conditions.

Var. FULGENS Lister has been found three times. It has longer and firmer stalks, and the color is brownish-red like that of our local *A. ferruginea.* The spores are up to 8.5 μ diameter, and

except for the smaller spores, there is nothing to distinguish it from *A. ferruginea.*

6. ARCYRIA INSIGNIS Kalch. & Cooke. The species bears no resemblance to *A. denudata* in size, color, habit, or habitat. Typical fruitings occur as small sporangia, in numerous small clusters a few millimeters across, and of a salmon color. They are on ground debris of leaves, twigs, and grass, or the stems of living plants, indicating that the plasmodia thrive in the substratum. It has been found behind my home at Mineola on living lilac; on sedges, stems, and dried eel grass, at Jones Beach; and at other places throughout the area; so that it is not uncommon during the late summer. In Mycologia **21**: 297–299, I proposed the var. *dispersa* for scattered and separated sporangia of this species that occur on dead grasses at Jones Beach. Numerous other minute, solitary sporangia are found there on the same grasses, and in color, shape and other characters are more like *A. pomiformis, A. cinerea,* or *A. denudata,* all of which develop normally at the same place. These should all be regarded as weak phases and not distinct variations, and as the var. *dispersa* is among them, I suggest its abandonment as needlessly encumbering the nomenclature.

We have often found small fruitings of an *Arcyria* colored like *A. insignis,* but larger in size, which in the past I have considered as var. *major* G. Lister. A further study of all of the material convinces me that it is not var. *major.* Those forms with long, dark red or brown stalks are *A. denudata,* and the majority, with short stalks and blunt prominences on the capillitium, are regarded as *A. carnea.*

7. ARCYRIA MAGNA Rex. A large and remarkable collection of this questionable species was made at Albertson, in September 1928. It appeared on an old log from which *Arcyria nutans* had been taken in a previous season, and *Arcyria cinerea* collected in close proximity. The fruiting was in a perfect state of maturity, and assumed to consist entirely of *A. magna,* but on closer examination it was observed that at one end it merged gradually into *A. cinerea,* including clusters with connected stipes, as in var. *digitata* of the latter species. This end had rather large, almost white sporangia, on long stalks, 6 mm. high in all, and a closely

meshed, non-expanding capillitium firmly attached to the cup. The size of the sporangia gradually decreased, meeting small forms of *A. magna*. About four-fifths of the development consisted of gray sporangia, with widely expanded, loosely meshed, drooping, capillitiums, 10–12 mm. in length, and very lightly attached to sessile or shortly stalked cups, when these were present. Frequently the capillitiums arise directly from the hypothallus by a few threads, without stalks or cups. The threads of the elastic network of the capillitium are pale yellow, about 3 μ wide, and ornamented with spines, cogs, and half rings. The spores are 7.5–8 μ diam., pale yellow, and faintly warted. The capillitium and spores are identical with those of *A. nutans* from the same locality, and the sporangia are practically the same otherwise, except in color. The threads of the inelastic capillitium of *A. cinerea* are pale yellow, somewhat thinner, and ornamented as in *A. magna*. The spores are pale yellow, faintly warted, about 8 μ in diameter. A large part of the collection has been on exhibition, for a year or more, in the Museum of The New York Botanical Garden, and during that time, exposed to daylight, it has acquired a distinctly yellow hue.

Another small collection of *A. magna,* made at Albertson in July 1933, is the same as the earlier one, except that the sporangia have well developed cups and short stalks, and *A. cinerea* is not present. The capillitium of another specimen, collected by Mr. Charles W. Roessle, in Brooklyn in 1928, is the same as in the Albertson specimens.

Miss Lister regards *A. magna* as a phase of *Arcyria Oerstedtii,* basing the opinion upon the presence of peridial fragments attached to the capillitium in a roseate form that Rex considered a variety of *A. magna*. There are no indications of peridial attachments in the gray forms from Long Island, and the roseate form of Rex may have had a different life history.

Arcyria magna is one of those forms that are rarely reported. It is possible, in the early part of the life cycle of the Mycetozoa, that gametes of different species may fuse occasionally and form a plasmodium whose fructification will be a hybrid between the two parents. The field conditions and study of the gray forms here

reported indicate that they are hybrids between *A. nutans* and *A. cinerea.*

8. ARCYRIA NUTANS (Bull.) Grev. Easily recognized by the large, yellow sporangia, with expanding capillitium that is almost free from the cup. Common throughout the season, although the larger fruitings occur in June.

9. ARCYRIA OCCIDENTALIS (Macbr.) Lister. One collection from Albertson is typical but others from various stations show an approach to either *Arcyria ferruginea* or *Arcyria stipata,* by differences in the spore size or variations in the markings of the capillitium. All, more or less, show the color change from brown or red to drab yellow, which is also frequently observed in certain phases of *A. stipata.* My specimens have slightly elastic capillitia, so that I cannot agree with placing the species in the genus *Lachnobolus,* to which it is not related otherwise than by the flaccid character of the capillitium in specimens from other parts of North America. The species seems to be on the line of transition from *A. stipata* to *A. ferruginea.*

10. ARCYRIA OERSTEDTII Rost. Only one certain collection of this species has been made, at Albertson in June 1924. It is typical, with numerous plates from the peridium attached to the capillitium, but the spines on the latter are not as long as usual. A second collection, from Great Neck, is placed here doubtfully. The capillitium is densely spinose, with spines 2–2.5 μ in length; the spores are warted, 8–8.5 μ diam.; the cup papillose and strongly reticulate with raised ridges. Both fruitings are perfectly matured and the color is brownish-red.

11. ARCYRIA POMIFORMIS (Leers) Rost. When typical, the small, globose, buff colored sporangia with a more open capillitium, distinguish the species from *A. cinerea.* The habit is also more scattered with fewer sporangia to the fruiting. It is common, and found everywhere on Long Island, but not abundant. There are numerous intermediate forms that connect it with *A. cinerea.*

12. ARCYRIA STIPATA (Schw.) Lister. The sporangia have a long period of development, with the consequent hazards of interruption during the process, which accounts for the many imperfect and immature forms that are found. In perfect developments the sporangia are well separated, of a brown, copper color,

and have an elastic capillitium. Imperfectly matured forms run to duller red, with the sporangia superimposed and jumbled together. Some of our collections have pronounced spiral windings on parts of the capillitium, but never on the whole, nor as regular as in species of *Hemitrichia*. The numerous, wide-based protuberances, pointed or truncate, are like those in *Arcyria*, and, all in all, the form when properly matured, looks more like an *Arcyria* than a *Hemitrichia*. The species is on the border between the two genera, and will likely continue to be a bone of contention as to where it belongs. It merges gradually into *Arcyria occidentalis*, with a line of intermediate forms connecting the latter with *Arcyria ferruginea*. Abundant on Long Island in numerous phases, on wood throughout the season, but more often collected in the later months from September on.

3. BADHAMIA Berk.

The species of *Badhamia*, other than *B. foliicola*, have seldom been found in the area covered. The capillitium is calcareous throughout with only an occasional, short, hyaline connecting thread. Intermediate forms resembling species of *Badhamia* have longer threads between the calcareous nodes, and are difficult to determine, as they indicate a physaroid character. It is necessary to assign them to *Physarum connatum* (Peck) Lister, *Physarum leucophaeum* Fries, or *Physarum notabile* Macbr., but there is no unanimity of opinion as to the distinctions between the last three.

1. BADHAMIA AFFINIS Rost. In June 1928, Mr. Rispaud found a small fruiting of a *Badhamia* developing on his lawn from a white plasmodium. The sporangia are sessile, appearing otherwise like *Badhamia foliicola* which has been collected nearby on several occasions. *B. foliicola* develops from a yellow or orange plasmodium. The spores of the collection are free, spinulose, and 11–15 μ in diameter, the smaller spores predominating. The form is not typical, but the presence of the larger spores and the white plasmodium indicate a close approach to *B. affinis*.

2. BADHAMIA DECIPIENS (Curtis) Berk. The yellow sporangia with yellow lime in the capillitium and free spores were found in the marshy land adjoining Meadow Brook, in what is now Meadow Brook State Park. One collection, in October.

3. BADHAMIA FOLIICOLA Lister. The species has been collected so often and at so many places from July to November in various years, that it may be regarded as one of our common forms. It seems to be almost unknown in this country, but has been found often, probably, and mistaken for some other *Badhamia* as it resembles a number of them in several of its phases. The sporangia develop in numerous, small patches on ground debris of sticks, twigs, grass, and leaves, and exhibit considerable variation. The color is a beautiful, iridescent, bluish-gray, with occasional patches having more lime in the peridium and showing white. Some patches consist entirely of sessile sporangia; in others, they are shortly stalked, the stalks, in length, less than the diameter of the sporangia. The stalks may be yellow and weak, or streaked with gray to almost black, or may be firmer. The spores range widely in their size, color, and markings, and are usually free, although sometimes in loose clusters, and, occasionally in fresh material, are firmly adherent, but separating later. An entire collection must be studied in its various phases in order to make a proper determination when the student is not familiar with the species. The form differs from all others with which it may be associated, by the habitat when clearly known; from *B. utricularis* by the shorter stalks; from *B. papaveracea* and *B. affinis* by the spore characters; and from *B. panicea* by the absence of the red hypothallus and the much more delicate capillitium.

4. BADHAMIA GRACILIS Macbr. A collection of this graceful species was made on bark in October, and compared with authentic specimens sent to me by Dr. G. W. Martin. In our material the spores are about 12 μ, closely warted, and some of the spores have a few small clusters of warts, or a line of warts across the hemisphere. The species was formerly regarded as a variety of *Badhamia macrocarpa* (Ces.) Rost., but the latter has not been seen on Long Island.

5. BADHAMIA LILACINA (Fries) Rost. The sporangia are pinkish or flesh colored when fresh, fading later to white. The peridial wall is opaque with lime and looks like a Diderma, but the capillitium is diagnostic. Our two collections were made at Mill Neck and Meadow Brook Park during the late summer and early fall, on stalks of living ferns and dead leaves.

6. BADHAMIA MAGNA Peck. The species was found in an advanced state of maturity, on a pile of stacked fire wood, when we visited the estate of William Willock, at East Norwich, during October. The following October, perfect collections were made a week earlier. Apparently it fruits but once a year, in this instance practically to a day, and we have noted this, occasionally, in other species. The golden yellow stalks are in many instances more than 5 mm. in length with large clusters of sporangia at the tops. There is much branching and joining of the stalks and frequently a number will coalesce from the base up—as in *Arcyria cinerea* var. *digitata*—to form a single, erect column supporting from forty to fifty sporangia. The latter phase presents one of the most handsome slime molds that I have seen. The spores are free, spherical, faintly spinulose, 10–11 μ diam.; the color is violet-brown, but not very dark.

7. BADHAMIA ORBICULATA Rex. Appeared in abundance on a locust arbor in the gardens of Doubleday, Doran & Co. at Garden City, and a year later on locust wood in Mineola, both appearances in July. Typical sporangia are sessile or shortly stalked, flattened and circular with a small depression in the center. The shape is formed by the plasmodium spreading horizontally as an open ring, the two ends of which finally join and close the middle, but leave the small circular or linear depression. There are numerous examples showing the junction lines of the fusion, and others where two or more sporangia have fused together. The capillitiums show by plates or thickenings along the lines of junction that they have followed the sporangial formation. Ring shaped plasmodiocarps are not unusual among the Mycetozoa, but here we see the process in its highest development with the ultimate formation of circular sporangia and the disappearance of all vestiges of the merging.

The method of sporangial formation is sufficient, in my opinion, to regard *B. orbiculata* as a distinct species, rather than to consider it as a variety of another where the process is outward in all directions possible, and not as a horizontal ring. The species, so far as reported, occurs only in North America and Asia.

8. BADHAMIA PANICEA (Fries) Rost. Occurs on dead wood in

the early part of the season to July inclusive. It has been collected in two successive years from the same log in the Albertson kettle hole, and also at Mill Neck. Externally, the sporangia resemble certain phases of *B. foliicola,* but the species is readily recognized by the reddish hypothallus which is present in all our specimens; the densely calcareous capillitium with a tendency to form a pseudocolumella; and the habitat.

9. BADHAMIA PAPAVERACEA Berk. & Rav. Represented by a single, small collection from a stack of fire wood in Mineola. The sporangia are typical with short, thick, black stalks, and spores firmly adherent in clusters.

10. BADHAMIA RUBIGINOSA (Chev.) Rost. While not common, the fructifications are frequently of great size. On two occasions in the Mill Neck swamp, the sporangia covered the stalks of living ferns for many yards around. Another collection on wood made in early February during an open winter has many sporangia with the tops breaking away as distinct lids. This feature caused earlier authors to place the species in *Craterium.*

11. BADHAMIA UTRICULARIS (Bull.) Berk. The species is related on one side to *B. foliicola* and on the other to *B. magna,* the principal distinction being in the length of the stalk, although in doubtful specimens the spore characters must be taken into consideration. In our single collection, on dead wood from Mineola, the thin stalks are, in length, two or three times the size of the sporangia, and the spores are free, lighter in color than those of our *B. magna,* but more strongly spinulose. September.

4. BREFELDIA Rost.

A monotypic genus with a well marked species.

1. BREFELDIA MAXIMA (Fries) Rost. May be recognized in the field by the dark, purplish-brown aethalia which are seated on a wide-spreading hypothallus, and are as much as 30 cm. across. The peridium is weak, the mass of spores breaking away freely after drying. It occurs in the Great Neck kettle hole, where it has been found in October of several years on stumps or living trees, a few feet above the ground. The plasmodium is white.

5. CERATIOMYXA Schröter

The genus has but a single species, *C. fruticulosa* (Müll.) Macbr., which is different from all other Mycetozoa in that the spores are on the outside of sporophores instead of within sporangia or aethalia. Another form, *Ceratiomyxa porioides* (Alb. & Schw.) Schröt., has been often regarded as a distinct species, but the tendency now is to accept it as a variety or phase of the former. Some years ago, I found the two developing from the same plasmodium, and I have been informed by other students that the phenomenon is occasionally observed. The species is sensitive to atmospheric conditions prevailing at the time of fructification, and as these change or the habitat is different, various phases are produced. These are not varieties, although they may be conveniently regarded as such. They are not geographically restricted, forming wherever the species is abundant and the conditions suitable. Extremely moist conditions will produce the typical form and var. *porioides,* the latter, probably with lower temperatures as we have observed it only after cooler periods. On dry wood, or elevated from the ground and exposed to gentle air currents, the fructification will be as var. *arbuscula* Berk. & Br. or var. *filiformis* Berk. & Br., which two Lister combines as var. *flexuosa,* as there is little difference between them. In var. *arbuscula,* the sporophores are stouter and the branches flattened because of their greater breadth, while in var. *filiformis,* the branches are more slender and rounded. In both varieties, the upper branches of adjoining sporophores often intertwine to form a dense, matted, surface. These last phases represent the highest development of the species, and it is unfortunate that a phase developed under adverse conditions should be regarded as the typical form.

1. CERATIOMYXA FRUTICULOSA (Müll.) Macbr. Abundant everywhere on Long Island, from June to October, in all the varieties or phases mentioned. Cream colored, yellowish, or pinkish forms also occur, but have no particular significance as the color depends, probably, upon the nature of the food supply of the plasmodium. Var. *descendens* Emoto has also been observed and is here regarded as a phase. It is perhaps the same as var. *dentata* Minakata.

6. CIENKOWSKIA Rost.

The genus is monotypic, and the single species may be recognized with a hand lens after a study of its characters and relations as given in either the Lister or Macbride & Martin monographs.

1. CIENKOWSKIA RETICULATA (Alb. & Schw.) Rost. A collection on small sticks and twigs from Mineola, in July 1928, shows a tendency to flat, effused plasmodiocarps, although sufficient openings indicate the netted character. A second and larger collection, on the same habitat from another place in Mineola, and found in September 1933, consists of numerous, flattened, thinly effused plasmodiocarps up to 20 mm. long and 6 mm. wide, with only a few openings in one plasmodiocarp. The last collection has a rather scant capillitium.

7. CLASTODERMA Blytt

Like *Comatricha* or *Lamproderma* in outward appearance, but the threads of the capillitium are forked, with persistent plates from the peridium at the outer ends. A single species is known.

1. CLASTODERMA DEBARYANUM Blytt. The sporangia are very small, 0.1–0.2 mm. diameter, on long stalks which are almost black for the greater part of their length and brown above. Our Long Island material usually shows the reddish, swollen portion about two-thirds of the way up from the base, beyond which the stalk becomes abruptly thinner. It requires good eyes to see the form on wet wood, but it is no doubt abundant as Mr. Rispaud has found it often, at various places, from June to September.

8. COMATRICHA Preuss

The genus, like *Stemonitis,* is a difficult one because of the many intermediate forms, and the absence of sharp distinctions between many of the species. It is separated from *Stemonitis* by the absence of the surface net to the capillitium, but in some species the net is more or less evident, although not so regular and well defined throughout as in *Stemonitis.* In studying the species of the genus, the characters of columella and capillitium are of primary importance.

1. COMATRICHA ELEGANS (Racib.) Lister. Mitchell Field is the permanent aviation post of the U. S. Army located near Mineola since the late war. During that period, lumber from all parts of the world has been brought there for various purposes of building construction, aeroplane work, etc., the poorer or decayed material eventually finding its way to the junk piles where we have made good collections. Our most interesting developments of *Comatricha elegans* came from there, and, show in an almost unbroken line of evolution the disappearance of the columella in the transition from *Comatricha nigra.* One fruiting has the stalks branching into two or three parts below and outside of the sporangia, each branch then forking within, the combined branches retaining the globose shape of the sporangia. The widest departure, where the columella is entirely absent and the capillitium expands and extends as a long cylindrical net, I have proposed as *Comatricha extendens.*

The Mitchell Field forms of *C. elegans* are shortly stalked, the stalks two or three times the size of the sporangia. It seems that variation is more evident in the shorter stalked forms, in some instances, developments from one plasmodium showing sporangia of both *C. nigra* and *C. elegans.* Often the capillitium is more lax, as in *C. laxa,* and again, lighter colored spores, distinctly warted, show a tendency towards *C. pulchella.* Long stalked forms of *C. nigra* and *C. elegans* are usually constant in the characters of columella and capillitium throughout the fructification.

The species is fairly abundant on Long Island, and has been found at many places on wood, throughout the season.

2. COMATRICHA EXTENDENS Hagelstein. Found fruiting indoors on the under side of flooring among steam pipes, in a hot, moist, environment. The form lacks a columella and suggests a separate genus, but I am convinced that it is allied to *C. elegans* and should be regarded as a *Comatricha.* Externally, it looks like a long stalked phase of *C. nigra,* but the capillitium rises directly from the stalk, and finally expands into a narrow plume, two or three times the size of the sporangial body. Proposed, described, and figured in Mycologia **27**: 374–375, 1935.

3. COMATRICHA IRREGULARIS Rex. Sometimes difficult to separate from *Comatricha longa* as intermediate forms occur and the

spores are often similar in both species. The smaller size, different habit, and capillitium distinguish *C. irregularis*. We have three collections, on wood during the autumn months.

4. COMATRICHA LAXA Rost. The important difference from *C. nigra* is in the open character of the capillitium as mentioned under the latter species, and it is subject to similar variation. All of our material has short stalks, and it may be said, generally, that all shortly stalked forms of *C. nigra* show a tendency to a more open capillitium. *Comatricha Ellisii* Morgan, a form intermediate between *C. nigra* and *C. laxa,* and among our material, has a capillitium somewhat closer than typical *C. laxa* but comes within the range of variation common to many of the Mycetozoa. It is regarded here as a phase of *C. laxa* as, in my opinion, there is little to justify specific rank. *C. laxa* is well distributed on Long Island, on wood throughout the season.

5. COMATRICHA LONGA Peck. The long, drooping, sporangia in clusters have been found frequently on wood from July to October.

6. COMATRICHA LURIDA Lister. Collected twice on leaves in July 1927, at Albertson, and so far as I know these are the first recorded collections from North America. It is closely related to *Comatricha rubens*. The Long Island specimens have globose, light brown sporangia on short, slender stalks. The columella divides at the top into the primary branches of the capillitium, and, while some of the threads are bent downwards, there are no attachments to the lower part of the columella, nor is there any firm, peridial base, with attached threads, as in *C. rubens*. After spore dispersal, which commences at the bottom, the capillitiums appear somewhat scanty and assume a hemispherical shape on top of the bare columellae. This permits a rough method of field analysis in differentiating between the two species. If the tops are ragged, it is probably *C. rubens*. If after the spores have commenced to fall away the sporangia appear ragged at the bottom, it is probably *C. lurida*. The spores of *C. lurida,* in our specimens, are of a light, violet-gray color, irregularly globose, distinctly warted, and measure about 7 μ.

7. COMATRICHA NIGRA (Pers.) Schröt. With *C. nigra* as a center, there are grouped a number of forms, closely affiliated, but which in their highest developments show such wide divergence in

the capillitium and columella, that they are regarded as distinct species. In typical *C. nigra,* the columella or continuation of the stalk passes through the sporangium to the top, or almost so, with the capillitium dense and attached by threads to all parts of the columella. When the capillitium becomes more open, the tendency is towards *C. laxa,* and in higher developments of the latter it consists of a widely meshed, loose net, not to be confused with the capillitium of any other Comatricha. In *C. elegans,* the columella divides into several branches forming the primary branches of the capillitium. In *C. extendens* there is a still further departure with the entire disappearance of the columella, and the netted capillitium springs directly from the top of the stalk.

Comatricha nigra is an abundant species on Long Island. It is subject to considerable variation in size and shape, often within the same fructification. The stalk varies in length, also the color and spore size. The majority of our specimens are globose, or nearly so; on long stalks; and of a dark, violet-brown color. Intermediate forms connecting it with *C. laxa* and *C. elegans* are not rare.

Var. *alta* (Preuss) Lister was collected once on dead, herbaceous stalks, at Albertson in June. The sporangia are shortly cylindrical, on long stalks with a weak upper capillitium.

8. COMATRICHA PULCHELLA (Bab.) Rost. The sporangia, under a hand lens, appear somewhat like forms of *C. nigra* or *C. laxa,* but the color of the capillitium and spores is paler, and the latter are distinctly warted. Var. *fusca* Lister has a darker and more robust capillitium. Var. *gracilis* (Wingate) Lister has slender, cylindrical sporangia that must not be confused with *Comatricha subcaespitosa* which they resemble superficially. The typical form and varieties are fairly abundant on Long Island, throughout the season, on leaves, ground debris, or living plants, but not on wood.

9. COMATRICHA RISPAUDII Hagelstein. Described in Mycologia **21**: 297, 1929. It appeared on leaves at Albertson in July 1927, in various fruitings, and again in September 1931, the last agreeing in every respect with the earlier ones. A typical collection was also made by Mr. Rispaud at Enfield Gorge, near Ithaca, New York, in August 1935.

10. COMATRICHA RUBENS Lister. Found several times at Albertson and Great Neck, on leaves, and may occur annually, but has not been searched for in recent years. The sporangia are obovoid, light brown with a touch of pink, and quite typical with the persistent, membraneous base of the sporangial wall attached by threads to the lower part of the columella. The spores are 6.5 μ in diameter, faintly spinulose.

11. COMATRICHA SUBCAESPITOSA Peck. From correspondence with other students I find that this species is apparently not clearly understood, and is probably often confused with *C. typhoides* or var. *gracilis* of *C. pulchella,* both of which it resembles superficially. The Listers have regarded it as a variety of *C. nigra,* to which in my opinion it bears no relation, but Miss Lister in correspondence has indicated a change of opinion. The surface net to the capillitium is more striking and pronounced than in *C. typhoides,* and brings the species near to *Stemonitis,* but it is no doubt better to regard it as a *Comatricha* where its greater affinities lie.

The form is abundant on Long Island, throughout the season on wood, in large fruitings of closely aggregated sporangia, the fruitings sometimes a foot or more across. The sporangia are cylindrical, usually curved with few erect, of a dark brown color, and on short stalks one-quarter or less of the total height. The peridium is concolorous, not silvery and persistent as in *C. typhoides,* and vanishes rapidly. The stalk is bare and not sheathed with a thin membrane. The spores in considerable material examined range from 6–8 μ and have a light violent-brown color by transmitted light. They are distinctly and uniformly warted, but never with the large, prominent, solitary warts observed on the spores of *C. typhoides.* It will be noted that the spore description does not agree with that given by Macbride and Martin. The only outside specimen of *C. subcaespitosa* that I have is from Maryland, and the spores there are identical with the Long Island spores.

The form is remarkedly constant so that tentative determinations may be made in the field with a hand lens on habit, shape, color, stalk, and absence of the silvery peridium. There is no question in my mind about its position as a distinct species.

12. COMATRICHA TYPHOIDES (Bull.) Rost. We have two phases of this species on Long Island, one developing on wood, and

the other with plasmodia vegetating in the moist sub-stratum, and fruiting on leaves and other ground material.

The wood form is fairly abundant throughout the season, in small fruitings rarely more than three inches across. The sporangia have the usual scattered habit; are lilac-brown in color; and have long stalks equal to or longer than the sporangial body. The persistent, silvery peridium is present, and the stalks generally show the thin, membraneous sheaths. The spores are smaller and paler than those of *C. subcaespitosa,* and invariably have the few, large, scattered warts that are seen to best advantage in the field of the microscope when on the edge of the spore.

For ten years past, annually in June and July, we have noticed in the Albertson kettle hole, numerous large fruitings of *C. typhoides* on leaves. On one occasion, almost every dead leaf in an area of two hundred square feet or more bore its part of the many thousands of sporangia. There is nothing to distinguish these from typical *C. typhoides* on nearby wood, except that the stalks are slightly shorter, about one-third the total height. It is interesting, nevertheless, to note that in the ground of this morainal depression, the plasmodium has adapted itself from the wood in which heretofore it has always been found.

9. CRATERIUM Trentepohl

The genus is related to *Physarum* and *Badhamia,* but set off by the shape of the sporangia and the lids thereon. Both features are well represented in most of the species.

1. CRATERIUM AUREUM (Schum.) Rost. Collected repeatedly on leaves in the Mill Neck and Albertson swamps, during June and July. The sporangia, when fresh, are usually golden yellow, but one gathering is gray with a reddish tinge. The lime in the capillitium is yellow, but fades to white along with the sporangial color.

2. CRATERIUM CONCINNUM Rex. Found several times on leaves, twigs, and ground wood, prior to 1927 but not since, and only at Albertson. The habitat is not as usually reported, the chestnut being extinct in the neighborhood for many years back. It is smaller than *C. minutum,* the lid is not depressed, and the lime-knots are brownish-yellow, fading to impure white.

3. CRATERIUM CYLINDRICUM Massee. The form is well differentiated in its shape, and easily distinguished from *C. leucocephalum*. While related to the latter variable species, it is the most constant and abundant—at least in North America—of the various forms connected therewith. Following other American students, I believe that it should be regarded as a distinct species. It is common on Long Island, throughout the season from July, on leaves, twigs, and similar material. We have handsome developments with sporangia formed like inverted, elongated bells.

4. CRATERIUM LEUCOCEPHALUM (Pers.) Ditmar. Of our two collections on ground debris, each apparently of several fruitings, the one from Great Neck shows considerable variation and a tendency towards *C. minutum*, but the crystalline discs in the sporangial wall are prominent. The other, from Meadow Brook, is divided into numerous phases, some close to *C. minutum* in the smooth character of the wall. In the Meadow Brook specimens, the lids in all phases are convex, white or concolorous with the wall, smooth or wrinkled. There are no discs in the wall or capillitium, but the majority of the fruitings are undoubted *C. leucocephalum*, and in the uniform absence of the thickened wall below the lid, I regard them all as phases of the variable *C. leucocephalum*, rather than mixed fruitings of the two species.

Var. *scyphoides* (Cooke & Balf.) Lister has been found twice on ground debris. The turbinate sporangia with brilliant red bases, stalks, and hypothallus, are characteristic. The base, in instances, approaches a distinct calyculus or cup.

5. CRATERIUM MINUTUM (Leers) Fries. Not uncommon and well distributed. All our collections, but one, have the lids depressed below the margins. The other has convex lids with most of the sporangia long cylindric in shape.

10. CRIBRARIA Persoon

Taxonomically, *Cribraria* is a difficult genus for the most advanced student, and an unsolvable puzzle for the beginner. Many of the species have no definite boundaries; they overlap and merge into each other; and there is added confusion in the varying interpretations placed upon the same form by different students. I

confess that I do not understand the genus thoroughly, and other students may disagree with my opinions and conclusions, but in going over specimens in my herbarium that were determined by others, I do not agree with them in many instances. In the main I have followed Lister as offering a better conception of the species of the genus and their relations to each other, and have then adapted my impressions to our local variations. These variations range through all our forms except *C. argillacea, C. laxa,* and *C. minutissima.* The size, number, and color of the plasmodic granules as emphasized by Lister, I have found of great value in diagnosis, at times, but not always.

The Long Island species of *Cribraria* are found throughout the season, usually more abundant in July and August. Ten species, as here recognized, have been collected, most of them frequently, and all on wood except *C. laxa.*

1. CRIBRARIA ARGILLACEA Pers. Collected repeatedly at Jones Beach from July to October, also at Glen Cove. All collections are typical.

2. CRIBRARIA DICTYDIOIDES Cooke & Balf. Several species of *Cribraria* are so close to each other that they appear to be no more than varieties. Aside from minor, unimportant differences, *C. tenella* differs from *C. intricata* only in the shape or form of the nodes of the net, and *C. dictydioides* from *C. intricata* by the absence of a cup. In perfect developments, these distinctions are well marked, but there are all sorts of intermediates between the three as well as between them and other related species. *C. dictydioides* is abundant on Long Island as it is elsewhere in North America. It is so striking in appearance, that it can be identified often with a hand lens or with the unaided eye, which cannot be said about *C. tenella.* I believe, particularly in *Cribraria,* that when a form is well marked at the extreme end of the range, also abundant and cosmopolitan, that it should be regarded as a species, at least until it is proven that the differential character depends upon varying conditions at the time of fructification. The form so far has not been observed in the field here after August.

3. CRIBRARIA INTRICATA Schrad. Macbride and Martin say in the description that the calyculus is lacking. All of our material has distinct cups, usually about one-third the height of the sporan-

gial body, and I interpret this as the important distinction from *C. dictydioides*. The parallel connecting threads between the prominent, irregular shaped nodes of the net, as mentioned by some authors, I have never seen emphasized, and doubt their value as a diagnostic character. The form is abundant and well distributed here.

4. CRIBRARIA LAXA Hagelstein. Described in Mycologia **21**: 298, 1929. A further collection was made at the type locality in September 1931. It was small and injured by water, but otherwise typical. So far, five collections have been made, all alike and always on leaves.

5. CRIBRARIA MACROCARPA Schrad. Typical material has not been found. We have one collection from the forest near Deer Park that has many large sporangia showing the dark, ribbed formation of the cup, but otherwise intermediate with *C. intricata*.

6. CRIBRARIA MICROCARPA (Schrad.) Pers. Miss Lister, in the Monograph, records the color as purplish-red with the spores pale red in mass. Our forms are not so. The color is yellow or ochraceous before spore dispersal, and the spores are yellow in mass. After the spores are gone, the net appears brown from the color of the enclosed granules in the nodes. In all other respects they agree with the Lister description and figures.

C. microcarpa is a small form on long stalks without a cup, and with prominent, dark, rounded nodes to the net. It is close to *C. tenella,* and in fruitings with very small sporangia there are others that approach in size the cup-less form of the latter species. Abundant and well distributed on Long Island.

7. CRIBRARIA MINUTISSIMA Schw. A typical and well matured development was obtained at Jones Beach in July on a fallen telephone pole.

8. CRIBRARIA PIRIFORMIS Schrad. Two collections from Belmont State Park have pyriform sporangia with deeply dentate cups, the nodes and cups densely studded with large, dark granules up to 2.5 μ in size. The spores measure 6–7 μ diameter and are distinctly warted. The forms are not typical, but are close to *C. piriformis*. Other collections from Jones Beach are similar in sporangial shape and cups, but the granules are smaller and not so crowded. They are nearer *C. vulgaris* var. *aurantiaca*.

9. CRIBRARIA TENELLA Schrad. Differs from *C. intricata* in the shape of the nodes of the net which are small and rounded. Most of our material has typically sized cups, but in some where they are obsolete the approach is towards *C. microcarpa*. Var. *concinna* G. Lister has been kindly determined for me by Miss Lister from material sent to her. The specimen examined and similar ones from here do not differ in color from our local *C. microcarpa* nor are there any differences worth noting. I regard the two as synonymous. *C. tenella* is not as abundant as *C. intricata* or *C. dictydioides*. but often collected and well distributed.

10. CRIBRARIA VULGARIS Schrad. Easily recognized under the lens by the usually broad, flattened nodes of the net. Our material, when fresh, has orange colored spores in mass giving a reddish appearance to the fruiting, and permitting a tentative determination in the field.

The student who will carefully study the descriptions and notes about this species in the Lister Monograph, and about *Cribraria aurantiaca* in the Martin and Macbride book, will note a difference of opinion as to the distinctions between them. Those forms where the nodes are flattened, branching, and lighter in color because of the absence of granules, I regard as *C. vulgaris*. When the nodes are more convex, or darker and crowded with granules, I regard the form as *C. vulgaris* var. *aurantiaca* (Schrad.) Pers. There are all stages of variation between them, and usually the spores of both have the orange color. Var. *aurantiaca* gradually merges into forms with slightly pyriform sporangia that have deeply dentate cups, and nodes and cups densely studded with granules, approaching *C. piriformis*. Both the typical form and variety are abundant.

11. DIACHEA Fries

The genus connects the calcareous Mycetozoa with the Stemonitaceae. All but one of the species are rarely reported or only from certain localities.

1. DIACHEA LEUCOPODIA (Bull.) Rost. A handsome form easily recognized by the stout, white stalks and cylindrical sporangia, which are iridescent before the peridium vanishes. It is often found in large colonies on twigs and leaves, or spreading

over dead and living bushes. It is fairly abundant on Long Island, and may be expected anywhere on a suitable habitat after June.

12. DICTYDIAETHALIUM Rost.

There is only a single species which is well marked by capillitial characters so that it cannot be confused with anything else.

1. DICTYDIAETHALIUM PLUMBEUM (Schum.) Rost. Found frequently on wood, after August, and usually in single aethalia. We have ochraceous, gray, and olive colored forms. A collection of five aethalia on charred wood, from Lakeville, is red in color, but not properly matured. It is probably var. *cinnabarinum* (Berk. & Br.) Hiranuma, and the color appears to be due to imperfect maturity.

13. DICTYDIUM Schrader

The genus differs from *Cribraria* in the sporangial wall, which here has ribs connected by slender threads, instead of the more or less perfect net with expansions or thickenings at the nodes. There is but one species, which is abundantly distributed throughout the world.

1. DICTYDIUM CANCELLATUM (Batsch) Macbr. Var. *purpureum* Macbr. and var. *fuscum* Lister are well represented in the numerous collections of *D. cancellatum* that we have made. The first, based on color, shades into the brown, typical form, if any of the many phases may be called typical. Var. *fuscum,* as found here and elsewhere in North America, is the highest development of the species. It is well figured by Macbride, in the 2nd. edition of the North American Slime-moulds on plate 19, fig. 1. The color is dark brown, with the ribs and stalks almost black at times. The sporangia are bell-shaped, with a prominent calyculus, in all a shapely, beautiful form. All phases of the species are common throughout the area.

14. DIDERMA Persoon

The small, spherical, granules of lime in the sporangial wall are sometimes so small, that, when separated in water, they display

the phenomenon of the so-called Brownian movement. This is caused by the constant motion of the molecules of water, and the resultant variations in pressure upon the particles of lime.

Four of the species here reported are abundant and well distributed in the area, but the other four have been rarely observed.

1. DIDERMA EFFUSUM (Schw.) Morgan. Among the many collections that we have made, and it is one of our most abundant species, we can recognize four distinct phases or varieties into which all the material can be divided. All the phases are common throughout the season.

The first, which is always on leaves in dry places, is an extremely thin, effused, patch, rarely more than 3 or 4 cm. across, and about 0.1 mm. thick. The fructification is continuous, in an even thin mass, not broken into separate sporangia or plasmodiocarps, although sometimes reticulate or showing lines of entirely confluent plasmodiocarps. There is little capillitium as there is no room for it.

The second phase consists of individual plasmodiocarps and sporangia, usually separated, but sometimes partly confluent. Here the fructification is always more or less flattened, but much thicker than in the first mentioned phase, and consequently, with a better developed capillitium. This is regarded as the typical form.

The next is like the preceding, but here the wall is beset with many crystalline discs or scales, often as large as 0.2 mm. across. At times the discs are so numerous that the entire wall appears hyaline, with a yellowish tinge. The discs are set in the calcareous wall but may be easily removed, and are similar to those in the genus *Lepidoderma*, showing an approach to that genus. Otherwise it is normal *D. effusum* with a columella represented by the slightly thickened, yellow or brownish base, and pale, almost smooth spores, 6–7.5 μ diam.

This variety has been found at Mill Neck and other places on many occasions. I have seen no prior record of it and propose the name *hyalinum* as it is distinct and constant.

The last phase is var. *reticulatum* (Rost.) Macbr., with well rounded, separate sporangia and plasmodiocarps, and an abundant capillitium. It is the highest development of the species.

D. effusum is very variable, and by intermediate stages approaches *D. testaceum, D. spumarioides,* and *D. hemisphaericum,* all of which occur on Long Island. Bleached forms of *D. testaceum* may be distinguished by the large, dark, hemispherical columellae *D. spumarioides* is recognized by the different habit, the larger and darker spores, the small, pale, columella, and the more or less adherence of the two layers of the sporangial wall. *D. hemisphaericum* resembles *D. effusum* when the stalks are absent, but the sporangia are discoid and larger.

2. DIDERMA FLORIFORME (Bull.) Pers. We have collected this species annually for a number of years, on and around a shaded stump at Albertson. Always in the period from early September until early November, and with but a single appearance, we conclude that here it is an autumn species, with but one annual fructification. We have it also from the Deer Park forest, on wood in October.

3. DIDERMA HEMISPHAERICUM (Bull.) Hornem. Frequent on leaves and other ground debris during July and August. A large gathering from Mineola has many sessile sporangia and plasmodiocarps, and approaches *D. effusum.*

4. DIDERMA MONTANUM Meylan. The species is so close to *Diderma radiatum* var. *umbilicatum,* that it is questionable if there are sufficient grounds for its separation. An authentic specimen kindly sent to me by Prof. Meylan is the same as our var. *umbilicatum,* except in the separable character of the inner sporangial wall. In the marsh at Meadow Brook, in late autumn, we find numerous small fruitings on mossy stumps that are close to the water's edge, many of which are poorly matured and others stained or bleached white. In fresh, perfectly matured specimens, the color is pinkish, with a dark red inner base, a red stalk, and the sporangia arise from a reddish hypothallus. The columella is small, very dark brown; the capillitium pale, hyaline; and the spores like those of *D. radiatum* or Prof. Meylan's specimen of *D. montanum.* The sporangial wall is clearly double, the inner membranous layer frequently separating from the outer one. The forms as described, I regard as *D. montanum,* but there are other fruitings from the same locality, where the double wall is not evident except in the dark coloring of the inner base, and these are

the same as forms from other marshy places in the area, and are *D. radiatum* var. *umbilicatum*.

I am of the opinion that *D. montanum* is the highest developed phase of *Diderma umbilicatum* Pers., and that the two are far more closely related than the latter is to *D. radiatum* of which it is considered a variety. A further and more exhaustive study of the North American material of *D. umbilicatum* may indicate that the presence of the double wall is more general than has heretofore been noticed, and that the wall structure is more like that of species in the subgenus *Eudiderma*. Most of our Long Island material follows that tendency.

5. DIDERMA RADIATUM (L.) Morgan. A small gathering of typical, brown sporangia, with stellately dehiscing walls, was made at Mill Neck, on wood. It seems to be rare, and local students are cautioned not to confuse it with *D. floriforme*, which it resembles in the field. The habit is separated, not crowded like in the latter species, and the spores, of course, entirely different. Var. *umbilicatum* (Pers.) Meylan has been found occasionally at several places, on mosses in the swamps, and also on wood at Jones Beach. Both are autumn forms, appearing after the middle of September. For further notes see *D. montanum*.

6. DIDERMA SIMPLEX (Schröt.) Lister. The belief that this species is rare in North America is apparently based upon insufficient evidence. We find it everywhere throughout the season, on leaves in wet, shaded, places, and sometimes in large fruitings. The color varies from occasional brick red, to more often ochraceous, and again almost white. In many of the best developments of separated sporangia, the hypothallus is hardly evident. In other specimens the sporangia are heaped and superimposed, in clusters, on a reddish hypothallus, and with large, hollow, columellae.

Var. *echinulatum* Meylan has been collected at Meadow Brook. The sporangia are well rounded, of a bright yellow color, and the spores are marked with strong, dark spines, which are much more pronounced than those on the spores of the typical form. The spores are identical with those on a slide of spores, courteously sent to me by Dr. Meylan.

7. DIDERMA SPUMARIOIDES Fries. It seems that we do not have this species in the large colonies of crowded sporangia as it is

usually found. Our collections are small, in separated sporangia, more as in *D. effusum*. The small, pale, columella is there; the layers of the sporangial wall are combined; and the spores are larger and darker, characters separating the species.

8. DIDERMA TESTACEUM (Schrad.) Pers. The pinkish, circular sporangia are to be sought for on leaves in marshy places. The color fades to white. It is common on Long Island, in small colonies, from June to October.

15. DIDYMIUM Schrad.

Separated from *Diderma* because of the crystalline nature of the lime in the sporangial wall. Usually this is in stellate crystals and well marked, but occasionally the lime may be as angular or irregular granules.

1. DIDYMIUM ANELLUS Morgan. The species, as represented on Long Island, seems to be extremely variable in capillitial and spore characters. We have a dozen or more collections from various places, no two of which are alike, but all of which are similar in their general appearance to one from Mineola, which consists mainly of small, centrally depressed sporangia, with circumscissile dehiscence, and short plasmodiocarps. The shape ranges, in other gatherings, to slender, elongated, or branching and netted plasmodiocarps, with few or no sporangia. The scanty lime deposits may be of small or large crystals; the capillitium of stout, flexuose threads, or slender threads, forking, branching or anastomosing; the spores vary in color from grayish-violet to darker, purplish-brown, faintly or strongly spinulose, and in size from 8.5–12 μ. Miss Lister suggested the probable species after examination of some of the earlier, obscure collections, and her judgment was confirmed by the later one from Mineola, which is typical. Two fruitings from Jones Beach, referred to in my paper on the Mycetozoa from Jones Beach State Park (Mycologia **22**: 259, 1930), and tentatively regarded as sessile forms of *Didymium melanospermum* (Pers.) Macbr., belong here. On leaves, twigs, and ground debris, throughout the season from July.

2. DIDYMIUM CLAVUS (Alb. & Schw.) Rab. By careful search, the species may be found on dry, dead, grasses, sedges, and stalks, at many places on Jones Beach. It has also been collected at

several other localities. It differs from similar forms by its shape, and the absence of a columella, which is replaced by the black, thickened base of the sporangial wall. July to September inclusive.

3. DIDYMIUM DIFFORME (Pers.) Duby. An inconspicuous form found frequently on Long Island, and probably common elsewhere, but overlooked as an uncertain slime mold. The small, white, flattened sporangia and plasmodiocarps, with smooth, eggshell like walls, resemble some phases of *Diderma effusum,* and may be mistaken therefore in the field. The fructifications are small, but usually numerous and scattered over a wide area on dead leaves, herbaceous stalks and stems, and other ground matter. Heaps of decaying hay, straw, and manure are also good habitats. Throughout the season.

4. DIDYMIUM EXIMIUM Peck. We have only one collection which has the pale, rough, discoidal columella. A gathering made in the Adirondack Mountains, with depressed, yellowish sporangia, agrees with the description of Macbride and Martin, and is so different from *D. nigripes* and *D. xanthopus,* that if considered as typical, it strengthens my opinion, that *D. eximium* should be regarded as a distinct species.

5. DIDYMIUM MINUS Morgan. The form is not rare, and may be found frequently among collections from wet areas, of the species of *Didymium* and *Diderma* that have similar habitats. It is sometimes regarded as a variety of *Didymium melanospermum* (Pers.) Macbr. from which it differs mainly in sporangial and spore size. The Long Island forms are constant in the small sized sporangia, about 0.5 mm., and the small spores, about 8 μ diam. We have not found *D. melanospermum* here, or any forms that are intermediate between the two species. Many collections of both, made in the Adirondacks by myself and associate, show the same distinct differences. Occurs on leaves, etc., and collected on Long Island during June and July, but probably fruits throughout the season.

6. DIDYMIUM NIGRIPES (Link) Fries. We have a few, small, gatherings of this species. The sporangia have dark, almost black, translucent, stalks, and the columellae are small, dark, and globose. In one of our collections the latter are elevated so that they are

in the center of the sporangia, a feature not uncommon in *D. xanthopus*. When the stalks are short, *D. nigripes* may be confused with long stalked forms of *D. minus*, but the stalks there are opaque. Rarely found, June and July.

7. DIDYMIUM OCHROIDEUM G. Lister. Found at Albertson in June and July 1926, July 1928, and August 1933, and also at Merrick in July 1926. The first collection is mentioned by Miss Lister in the original description of the species (Jour. Bot. **69**: 297. 1931). The fruitings are very small, less than 1 sq. cm., and are on leaves, stalks, etc. The slender plasmodiocarps and depressed sporangia are yellow or ochraceous in color, and thickly coated with large, stellate, crystals of lime. All the earlier collections have spores that are practically alike, pale, violet-gray, almost smooth, 6–7 μ diam. The last, made in August 1933, has larger, darker spores with a brownish tinge. They are distinctly warted and the size is about 8 μ. The species appears to be related to *D. anellus*, and resembles phases of the latter as found on Long Island, except in the color, and the paler, smaller, and smoother spores. An apparently intermediate form from Albertson has white sporangia and plasmodiocarps, that show in parts a slightly yellow tinge, and have an orange colored floor. The spores measure 9–9.5 μ, slightly darker and rougher than the 1933 specimens of *D. ochroideum*. I regard this form as nearer to *D. anellus*, but showing a relationship to *D. ochroideum* in the yellow tints.

8. DIDYMIUM SQUAMULOSUM (Alb. & Schw.) Fries. One of the most variable, and at the same time, one of the most abundant of the Mycetozoa. We find it everywhere, in all of its numerous phases, on leaves and other ground matter, throughout the season. The white, circular hypothallus is absent in many of our collections of sporangia. Stalked and sessile sporangia, with a wrinkled crust of lime crystals, are frequent. From Jones Beach we have elongated plasmodiocarps, several millimeters in length, with stalks at each end that continue through and join as columellae. We also have diffused, netted plasmodiocarps, which closely resemble certain phases of *Didymium anellus*, and can only be distinguished by the presence of an occasional sporangium. The species offers some difficulties to the student because of the numerous variations,

but the recognition becomes easier after a little acquaintance with them.

9. DIDYMIUM XANTHOPUS (Ditmar) Fries. This is our most abundant species, and so constant that it may be recognized with a hand lens, or, when better known, with the unassisted eye. It fruits everywhere on leaves, in wet, shaded places, and at appropriate times, after a few days of dry weather, may be observed in thousands of sporangia. Not uncommon are colonies with sporangia free from lime, which are probably *Didymium affine* Raunk., although the latter is regarded as synonymous with *D. squamulosum*. The plasmodium is colorless.

D. xanthopus, together with *D. eximium* are regarded in other quarters as varieties of *D. nigripes,* although when typical, the three forms are distinct in important characters that can be readily recognized. *D. xanthopus* has globose sporangia, an orange or reddish stalk, and a pale yellow or white, globose or turbinate, columella; *D. nigripes* has globose sporangia, a dark almost black stalk, and a small, dark, globose columella; *D. eximium* has somewhat depressed sporangia with a yellowish color, an orange to reddish stalk, and a rather large, pale, discoidal columella, that is more or less rough. While intermediate forms do occur frequently, I have not found variation among the sporangia of the same fruiting. It seems to be better to regard the three forms as separate centers with specific rank, which is done so often with others that are much closer to neighbors than these are.

16. ENERTHENEMA Bowman

The sporangia of the genus are like those of *Comatricha* in form, color, and stalk, but the stalk continues through to the top, and expanded there, appears as a shining disc on the outside top.

1. ENERTHENEMA BERKELEYANUM Rost. Since the first collection from Long Island in 1926 (Mycologia **19**: 315–316. 1927), Mr. Rispaud has found it on timbers, at the Army Base pier in Brooklyn, in June 1931, and at Mitchell Field in September 1933 and June 1934. All the collections are similar in the varying size of the sporangia, and the color also varies from purplish-brown to almost black, sometimes in the same colony. The spores

throughout are clustered, strongly spinulose on the exposed surface, purplish-brown in color, and measure 12–13 μ. Otherwise the form is like *E. papillatum*.

This form with clustered spores is rare, as it has been reported on two occasions only, aside from the Long Island collections. Its entry into Long Island is indicated somewhat by its collection in Brooklyn, and subsequent occurrences at Mitchell Field. The Brooklyn locality is the U. S. Army Base pier on New York Harbor where transports carrying troops and army supplies are docked. Mitchell Field is the U. S. Army Aviation Field near Mineola. I do not believe that the form is indigenous, but that the spores have come here from elsewhere by modern means of transportation, and, finding suitable conditions, have germinated and developed. Perhaps, in some other part of the world, the form is common, but lacking students, has not been observed.

2. ENERTHENEMA PAPILLATUM (Pers.) Rost. A fairly abundant species although much of the material is in poor condition, as the sporangia are fragile, and the spores and capillitiums are soon dissipated. It fruits on wood, throughout the season, but is more abundant in late May and June. The species has free spores, and all collections should be examined closely, in order to make certain that they are not the rare *E. Berkeleyanum*, which is similar, but has clustered spores.

17. ENTERIDIUM Ehrenb.

1. ENTERIDIUM OLIVACEUM Ehrenb. Not rare in recent years, as it has been found three times with forest surroundings, three times on timber stored on the Army Base pier in Brooklyn, and three times on the old wood piles at Mitchell Field. The species is more abundant in Europe than it is in North America, and here again it is suggested, that its migration into Long Island may be traced to its arrival, since the late war, in transports carrying troops and war material. The form has many aethalia to the fructification, and a thin, silvery, fibrous-like hypothallus is often present. The spores in all collections are olive-green in mass, and yellow by transmitted light. In all but one gathering, they are in large clusters, marked on the exposed surface with strong, pointed, spines, and measure 9.5–12 μ. A large collection from Albertson

has free spores, 11 μ in size, and minutely spinulose over the entire surface. This is *Enteridium simulans* Rost., and may well be regarded as a distinct species, but I am informed that forms with free spores are frequently found in Europe, and that no particular importance is attached thereto. On wood, June to November.

2. ENTERIDIUM ROZEANUM Wingate. At times it is difficult to distinguish this species from *Reticularia Lycoperdon* Bull. If the aethalium is small, of a chestnut-brown color, and seated on a white, spreading hypothallus, it is probably *E. Rozeanum;* but if doubtful, there is only one way to make certain, and that is by cutting into the aethalium, blowing out the spores, and examining the pseudo-capillitium, as the spores of the two species are similar and nothing can be learned from them. This analysis usually ruins the specimen. The larger aethalia approach the silvery color of *R. Lycoperdon,* but generally, are more irregular in shape, or consist of confluent, smaller aethalia. They are also often infested by the larvae of insects. The form is common, usually in single aethalia, but occasionally with more. We have one development of twenty-four. On wood, in the late season after August.

18. FULIGO Haller

The genus is represented on Long Island by two species, one of which is abundant and the other not rare. The fructification is aethalioid, and the colors conspicuous enough to be easily seen in connection with the large size.

1. FULIGO CINEREA (Schw.) Morgan. Not at all rare if looked for on the proper habitat. We have found it, in large developments, on almost every pile of hay, straw, and manure, in shaded places, that we have examined during the first or second year of decay, and also occasionally in the forest on leaves and twigs. The forest fruitings are small, and should not be confused with *Fuligo septica* var. *candida* which is far more common there. The large, dark, rough, spores, ellipsoid in all of our material, are determinative. Var. *ecorticata* Lister is associated, more or less, with the typical form when on debris piles, and seems to be only a phase developed under changing meteorological conditions. Found from July to October.

2. FULIGO SEPTICA (L.) Weber. The species, abundant throughout the season, occurs in almost every variety and phase that has been described or mentioned. The color ranges from pure white, through all shades of yellow and red, to deep brown. In almost all of our material it is only the outer line that is colored, the lime in the capillitium being white. The capillitium may be densely calcareous, or again, more physaroid with small, fusiform, lime knots. We have several small aethalia about 5 mm. in size, that have thin, iridescent, membranous walls, scantily beset with crystalline lime granules, and an abundant capillitium without lime.

There is no end to the number of varieties that may be proposed in the species. I follow the division of Lister, based on color regardless of the shape of the aethalia or the nature of the cortex. Yellow forms of all shades, from lemon to deep orange, are considered typical. Var. *candida* (Pers.) R. E. Fries is the white form, quite common here in individual, small, aethalia, and at times in larger, pulvinate masses. The latter resemble *Fuligo cinerea,* from which it can be distinguished by the smaller, globose, almost smooth, spores. Occasionally, in the latter phase, the outside lime is in crystalline granules, densely sprinkled. The red forms, ranging to dark, chocolate brown, are all regarded as var. *rufa* (Pers.) R. E. Fries, and are not rare, but always in single aethalia and smaller than the typical, yellow form.

From our observations it is indicated that the plasmodia of the typical phase inhabit the ground or substratum. Fructification is often on wood or living trees, far up from the ground, but in such instances it is evident that the plasmodium has travelled in the search for food, and failing therein, was obliged to go into fruit. Developments on ground material are generally larger, more effused or broken up, and with impure or mottled colors; on wood, they are more compact, rounded, and with cleaner, brighter colors. Var. *candida* has plasmodia thriving in decaying wood. The less common var. *rufa* has not been studied so closely. The plasmodial color of the species is yellow or white.

19. HEMITRICHIA Rost.

Related to *Trichia* and *Arcyria.* From the former it is separated by the netted character of the capillitium; from the latter, by

the spiral bands thereon. The color of the sporangia is some shade of yellow except in *H. vesparium,* where it is red.

1. HEMITRICHIA CLAVATA (Pers.) Rost. Easily recognized, and common on wood in all months of the season, but rarely in fruitings more than 8 to 10 cm. across. It varies much in general appearance, size of sporangia, and other characters. One of our gatherings from Deer Park has a well developed red hypothallus indicating a red plasmodium. The plasmodium is white, usually.

2. HEMITRICHIA INTORTA Lister. Some years ago, we found in the Deer Park forest, in January, a development agreeing with the description of *Hemiarcyria longifila* Rex, which Lister makes synonymous with *Hemitrichia intorta.* Later in February, and again in November of the same year, similar developments were found. They all have a very elastic capillitium that may be drawn out to a length of 10 to 15 mm., and thick, short, stalks, filled with spore-like cells at the top, but not so evident at the base. The late Prof. Macbride, and other students to whom the form was sent, regarded it as *H. intorta,* but it appears to me now after further study, as a cold weather phase of *Hemitrichia clavata,* which latter is sensitive to such conditions. Rex in the description of *H. longifila,* emphasizes the elastic capillitium and the similarity to *H. clavata,* and the question arises that Rex's form may also be an abnormal phase of *H. clavata,* and that interpretations of *H. intorta* based upon *H. longifila* may be uncertain. *H. intorta* has been rarely reported from North America. Our specimens are doubtfully placed here.

3. HEMITRICHIA SERPULA (Scop.) Rost. A beautiful species when perfectly developed and mature. The yellow, branched plasmodiocarps are common, on wood throughout the season. The plasmodium is yellow.

4. HEMITRICHIA STIPITATA (Massee) Macbr. I report this form because it may be a distinct species, but I have doubts. It occurs on Long Island, quite typical, including sporangia on confluent stalks as mentioned by Massee. It seems to be a wide departure, in certain directions, from the variable *Hemitrichia clavata,* which has other phases equally as far away. Our forms have long, thin, stalks, weak at the top so that the sporangia nod, the

stalks at times confluent in doubles, either joined at the bases, or, almost to the tops and without vestiges of the merging. The cup is shallow, the peridium turned down over it and breaking away in small circular plates. The capillitium is smooth, with no free ends, and the mass rounded, and paler in color than typical *H. clavata.* One or more of these features are frequently observed in other phases of *H. clavata,* and their combination here, with nothing very distinctive, seems to be insufficient to regard the two as specifically distinct. It merges gradually into *H. clavata,* so that there is no way of determining where one commences and the other ends, and only in rare instances is it possible to completely reconcile specimens with Massee's description. Four collections on wood.

5. HEMITRICHIA VESPARIUM (Batsch) Macbr. Easily recognized in the field by the red color and clustered sporangia, which resemble a miniature wasp's nest when the cups are empty. We have beautiful examples from Great Neck, with circumscissile dehiscence by a perfect lid. Common, on wood throughout the season.

20. LACHNOBOLUS Fries

A monotypic genus. Two other species included by Macbride and Martin are clearly *Arcyria,* resembling *Lachnobolus* only in the occasional, flaccid capillitium, a feature frequently noticed in other species of *Arcyria.* One of these species is reported in this paper as *Arcyria occidentalis* (Macbr.) Lister.

1. LACHNOBOLUS CONGESTUS (Somm.) Lister. Said to be rare in North America, but we have four collections from three different places, one of which was my back yard where it developed on old sugar bags used in covering plants. The fruitings are very small, and may be mistaken, when old, for faded forms of the more common *Trichia persimilis* or *Oligonema nitens.* The spores and capillitium, of course, are diagnostic. September to November.

21. LAMPRODERMA Rost.

The sporangia of the genus are beautiful with their metallic tints of blue, silver, and brass. Species cannot be distinguished in the field very well, so that it is better to analyse each collection as to

capillitium, columella, and spores. There is considerable variation in the same species from different territory, but our Long Island forms are typical and constant, so that they may be determined without difficulty, by the characters mentioned.

1. LAMPRODERMA ARCYRIONEMA Rost. Common on wood throughout the season. The species is recognized by the columella which penetrates the sporangium about half-way, and then divides into several branches forming the primary branches of the netted and anastomosing capillitium.

2. LAMPRODERMA COLUMBINUM (Pers.) Rost. The columella in all of our material is long and tapering, with the capillitium radiating from all parts of it. The collections are from the swamps on mossy stumps, from about the middle of September and through October. Our best field is along Meadow Brook, east of the Village of Roosevelt, where it fruits annually in abundance.

3. LAMPRODERMA SCINTILLANS (Berk. & Br.) Morgan. A very small form that is difficult to find and fruiting on leaves, stems, grass, etc., during the summer months. We have it from several places where careful search has been made, and it is probably common enough but escapes detection. Sporangia from Jones Beach are only 0.15 mm. diam. In this species, as well as in *Lamproderma violaceum,* the capillitium springs from the top of the columella only. The capillitium here is brown or dark to the tips and somewhat pale at the base where it leaves the columella. The spines on the spores are stronger and more separated than in *L. violaceum.*

4. LAMPRODERMA VIOLACEUM (Fries) Rost. The capillitium is pale, or when darker, the extremities are pale, so that if the sporangia are blown out they present a hoary appearance. The spores are larger than in *L. scintillans* and more closely spinulose. We have but a single collection, which is odd, as the species is fairly common elsewhere.

22. LEOCARPUS Link

A monotypic genus.

1. LEOCARPUS FRAGILIS (Dickson) Rost. A handsome form to be found on leaves, twigs, etc. It is common and observed several times during a season.

23. LICEA Schrad.

1. LICEA BIFORIS Morgan. An extremely small form and rarely reported because of its habitat beneath the bark of dead trees. It may be necessary to strip many trees and go over them with a lens in order to find the yellow, almond-shaped sporangia, although the frequent association of the species with the much larger *Perichaena corticalis* is of aid in searching for them. We have five collections, from July to October.

24. LINDBLADIA Fries

A monotypic genus close to *Cribraria,* but with the sporangia confluent to form aethalia.

1. LINDBLADIA EFFUSA (Ehrenb.) Rost. Not well distributed over the area. We have found single aethalia on two occasions at Albertson, and, at Jones Beach, numerous developments were taken, over two seasons, from old textile rubbish. The latter were in company of *Cribraria argillacea,* but without intermediate forms. It is difficult sometimes to separate specimens from certain phases of *Tubifera ferruginosa.* The walls of the confluent sporangia are studded with the so-called plasmodic granules which are not present in *Tubifera.* June to September, on wood.

25. LYCOGALA Adanson

1. LYCOGALA EPIDENDRUM (L.) Fries. Appears in the spring in small, feeble, fruitings, from the sclerotium revived by the warmth and rains. In later developments, from August to the end of the season, the aethalia are larger and more robust, and the distribution is wider. An interesting fruiting of a thousand or more aethalia, on the sand of Jones Beach, came from plasmodium in a large quantity of old, wood-pulp newspapers buried in the sand. Common on wood.

2. LYCOGALA EXIGUUM Morgan. This may be a variety of *L. epidendrum,* but it is always smaller, and darker in color; and is never in the company of the latter. It occurs only in certain places, and in the Albertson kettle hole, where *L. epidendrum* is frequent, it has never been seen. On wood, from July, and not rare.

3. LYCOGALA FLAVOFUSCUM (Ehrenb.) Rost. Has been collected a number of times, on wood, at widely separated stations, and as often as four times in one season. The aethalia are so large and conspicuous that they cannot be missed, yet they were seen only in the years 1924, 1928, and 1933 and not intervening. The occasional appearance has been noted by others.

26. MUCILAGO Adanson

The genus, with its crystalline lime, is similar to *Didymium,* but the sporangia are confluent and form effused or pulvinate aethalia. There is only one species.

1. MUCILAGO SPONGIOSA (Leyss.) Morgan. Has been found only at Albertson, on a pile of manure, where it appeared three times successively, from July to September in 1933, and not since. It is peculiar, that the first fruitings have spores 2–3 μ smaller than those of the later one, which are 12 μ. All the spores are very dark, almost opaque in water, and strongly spinulose.

Several solid, compact, aethalia of var. *solida* Sturgis were collected on cottonwood at Mitchell Field, the largest about 3 cm. across. They appear much like *Fuligo septica* var. *candida,* and have closely interwoven sporangia covered by a thick crust of lime, not at all like the loosely clustered, irregular sporangia of the typical form. There is not much difference in the spores or capillitium. The black spore mass distinguishes the form from *F. septica* in the field, and the crystalline lime, with spore characters, are diagnostic.

27. OLIGONEMA Rost.

A genus closely related to *Trichia,* with the sporangia heaped or clustered, and with faint or obscure spirals on the elaters of the capillitium.

The words dextrose and sinistrorse are confusing, as applied by authors in contradictory ways to the windings of the spirals in this genus and the genera *Trichia* and *Hemitrichia.* In *Oligonema flavidum,* the spirals wind in a contrary direction to those in species of *Trichia.* Likewise in *Hemitrichia leiocarpa,* but the figures of the latter in both the Lister and the Macbride and Martin monographs depict them in the same way as in *Trichia.* A simpler way

of explaining the direction of the windings is to consider them as similar to those of a screw-thread. An ordinary screw has what is called a right-handed thread. A thread winding in the other direction is called a left-handed thread. In all species of *Trichia, Hemitrichia* and *Oligonema,* reported in this paper, except *Oligonema flavidum,* the spirals wind like a left-handed thread. In the species excepted, they wind like a right-handed thread or ordinary screw. The direction of right and left is not affected by the usual reversal of the image in the microscope.

1. OLIGONEMA FLAVIDUM Peck. Common, on wood throughout the season. The sporangia are larger than those of *O. nitens* and ovoid in shape, the longer axis two or three times that of the shorter one. The habit is more scattered, or as a single layer of compressed sporangia, not heaped or superimposed. The spores are more regularly reticulate, and the elaters of the capillitium are rougher. All of our material shows obscure spirals, the direction of which cannot be clearly determined, except in one instance. Lister says that the spirals wind dextral, which is synonymous with dextrorse; Macbride and Martin say sinistrorse, the opposite of dextrorse; but both words are intended to indicate the same course of direction. The use of the words depends upon the point from which the spirals are viewed. They have been variously applied by botanists, zoologists, and authors, and even in dictionaries, the definitions are not uniform. Forms with very small elaters are frequently observed in this species, as well as in *O. nitens.* They are not regarded as of particular significance, although described by Peck as *Oligonema brevifilum.*

2. OLIGONEMA NITENS (Lib.) Rost. Common on wood, throughout the season. None of our material shows any traces of spirals. The capillitium is smoother, and the spores more irregularly reticulate than in *O. flavidum,* but the forms merge somewhat in their inner characters. The smaller, globose or sub-globose sporangia, and the heaped or superimposed habit, are usually sufficient to distinguish it from allied species.

The spirals on the elaters, when evident, wind as a left-handed screw. Macbride and Martin say dextrorse in the description, and sinistrorse in the paragraph following. The first is proper from their view-point of the application of the words.

28. PERICHAENA Fries

Four species of the genus are abundant and well distributed over the area covered. More than sixty perfectly matured collections show many intermediate forms between them, and the relations of the species to one another are so clearly indicated by a study of the collections, that I can see no reasons for separating *Perichaena chrysosperma* and *Perichaena vermicularis,* and placing them under another generic name. There are no differences of importance between the present genus and *Ophiotheca.*

1. PERICHAENA CHRYSOSPERMA (Currey) Lister. The species forms curved, ring-shaped, or elongated plasmodiocarps, with now and then sessile, globose sporangia, and may be distinguished from other species of the genus by the long spines on the capillitium. The fruitings, on bark, are very small, and almost concolorous with the habitat. Macbride and Martin regard the species as confined to forms with short spines on the capillitium, spores 7–9 μ, and lighter colored plasmodiocarps, and place it in the genus *Ophiotheca* Currey. Forms with long spines, larger spores, and chestnut-brown or black plasmodiocarps are regarded as *Ophiotheca Wrightii* Berk. & Curt. We have one collection of chestnut-brown color, with spines 1 μ or less in length, and spores 7–8 μ. Several others, varying in color from yellowish to brown, have spines up to 3 μ, and spores 8–9 μ. The most of our material has long spines, from 3–6 μ, spores 9–10 μ, and the color is either yellowish-brown or chestnut-brown, sometimes varying in the same fruiting, and perhaps due to drying in the later stage of maturity. The spines vary considerably in length, sometimes on the same capillitium, and as the other characters seem to be inconstant, it seems to me better to regard all these forms as phases of *P. chrysosperma.* One of our collections has no spines whatever on the capillitium, and the spores are 9.5–10 μ. It consists of yellowish-brown sporangia and a few curved or ring-shaped plasmodiocarps, with irregular lines of dehiscence, sharply defined, as in some phases of *P. corticalis.* It is placed with the present species but apparently approaches the latter. Common and often collected in the later months of the season, after August.

2. PERICHAENA CORTICALIS (Batsch) Rost. Typical forms as found here are sessile, subglobose, not crowded or polyonal, dehiscing along broad lines of areolation, or in a circumscissile manner with a distinct lid. The capillitium is scanty, and the spores 12 μ or more in diameter. Collections with sporangia rounded on top, but polygonal in shape by pressure, and crowded together or arranged in irregular chains, have a more profuse capillitium and spores about 10 μ. They are common, and regarded as phases of the present species, as usually no typical forms of *Perichaena depressa* are with them. However, one collection has large, typical sporangia of the latter present, and indicates that the other forms may be intermediate between the two species. All phases are common in the later months of the season from September on. Usually beneath the bark of decaying, fallen trees.

3. PERICHAENA DEPRESSA Libert. Typical examples are distinguished from *P. corticalis* by the larger, polygonal, depressed or flattened and crowded sporangia, with smaller spores, about 10 μ, and a more profuse capillitium; but there are many collections of intermediate forms. We have large, hemispherical sporangia with small spores. Others, similarly shaped but smaller, have spores about 11 μ, and approach *P. corticalis*. The main distinctive character between the two species is the shape of the sporangia, as assumed in fructification. Spore and capillitial characters, as well as manner of dehiscence, differ so much in the intermediate forms, that it is impossible to say with certainty where they belong unless typically shaped forms are present. *P. depressa* is common, in color variations from reddish-brown to black, and the lid is occasionaly sprinkled with lime. On wood, usually beneath the bark, throughout the season from July.

4. PERICHAENA VERMICULARIS (Schw.) Rost. Common and occurs usually on dry stalks of dead plants, thistle, sumach, etc., also on leaves, twigs, and the outside bark of dead trees. The species forms slender, elongated, or netted, plasmodiocarps, with occasional rings or sporangia. The color is ochraceous or umber, lighter than in *P. chrysosperma,* from which it is distinguished also by the larger spores and the different capillitium. Throughout the season.

29. PHYSARELLA Peck

A monotypic genus.

1. PHYSARELLA OBLONGA (Berk. & Curt.) Morgan. A beautiful form and not rare. Our best developments are from a decaying log, in a dense thicket, in the Great Neck swamp, where it appeared twice each season for a number of years, as sporangia and plasmodiocarps. On these occasions it was associated with *Physarum polycephalum* Schw., and at another time with *Physarum gyrosum* Rost. There may be some close relation between the three species as usually we have found two of them together on the same host. July to September.

30. PHYSARUM Pers.

This, the largest genus of the Mycetozoa, is not as well represented on Long Island as other genera are proportionately to the number of species. Forms found inland, not far away, are rarely seen here or not at all. We have noticed that certain species are confined to a few small areas and fruit there repeatedly. We hope to uncover new hiding places and discover forms that we feel are here, but, small and on leaves, are rarely seen.

The genus is allied to *Badhamia,* differing in the character of the capillitium. The key to the species of the genus in the Lister Monograph is of inestimable help in making determinations, and the student is advised to master it thoroughly. In typical cases, and keys are based on such, the species may be worked out, almost invariably.

1. PHYSARUM BOGORIENSE Racib. A small gathering on decaying grasses, at Jones Beach in September, is quite typical, and was verified by Miss Lister.

2. PHYSARUM CINEREUM (Batsch) Pers. Abundant throughout the season on leaves, twigs, etc. There is much variation in the amount of lime in the capillitium, and in the spore size, the latter from 7–11 μ. Certain collections, with large sporangia 1 mm. across, or with large spores and abundant lime, were formerly regarded as *Physarum vernum* Somm., a species allied to *P. cinereum.* A careful study of an extensive amount of material collected here convinces me that *P. vernum* is not among it, and

that all the collections are phases of *P. cinereum*. *P. vernum*, as shown by Swiss specimens, is large, with much lime, and darker, larger, rougher, spores. One or more of these characters are always missing in our doubtful material.

3. PHYSARUM CITRINUM Schum. Rare, as it has been found only twice. The sporangia are more robust than in *Physarum tenerum*, and are on stouter stalks. The yellow lime-knots are larger and irregular in shape, not rounded. In one of our collections, the columella is obsolete. July and August.

4. PHYSARUM COMPRESSUM Alb. & Schw. Colonies of laterally compressed sporangia are not rare, usually on ground rubbish, but also on wood. I include only such colonies with compressed sporangia throughout, or, which among more irregularly shaped ones, show indications of compression with splitting along the ridge. One collection, that cannot be assigned here clearly, is put with the irregular group discussed under *Physarum notabile*.

5. PHYSARUM CONFERTUM Macbr. The species is close to *P. cinereum*, and sometimes difficult to separate, but the combination of heaped sporangia, with larger spores, is generally sufficient to distinguish it. There are phases of *P. cinereum* with large spores, and the sporangia not heaped; other phases have somewhat clustered sporangia, but small spores. *P. confertum* is also close to *Physarum virescens*, which it resembles except for the yellow color. The species is common on Long Island, more often in July and August. It fruits on leaves, frequently on living plants, which the white plasmodium ascends before fruiting.

6. PHYSARUM DIDERMOIDES (Ach.) Rost. Usually on locust wood. Common from July to October, more often in the later months. Specimens kindly determined for me by Miss Lister as var. *lividum* are both sessile and stipitate, and appear as groups in developments of the typical form. I doubt that the variety is more than a phase of this variable species.

7. PHYSARUM FLAVICOMUM Berk. Not rare in the months from June to September. The sporangia are always gray, steel-blue, or iridescent bronze, but not yellow. A gathering from the Army Base at Brooklyn is remarkable for the great amount of lime in the capillitium. Another from Mitchell Field, with direct lines of communication from the Army Base, has far more lime than

usual. In a second collection from Mitchell Field, the nodes of the capillitium are deep orange-colored, almost brown.

8. PHYSARUM GALBEUM Wingate. May be said to be common as we find it almost every season while examining leaves and twigs in the search for ground species. The fruitings, however, are very small, consisting rarely of more than a dozen or so sporangia. The dense capillitium is almost limeless, and the threads range in color from pale yellow to hyaline.

9. PHYSARUM GLOBULIFERUM (Bull.) Pers. The species is common on wood from July to October. The stalks may be stout or slender, varying in the amount of the included lime, and at times confluent or branching with clustered sporangia. When the capillitial lime is more angular or branching, and yellowish in color, the approach is towards *Physarum murinum*. Much of otherwise typical material shows a tendency to pale yellow in the color of the lime. Other gatherings approach *Physarum notabile*, in external appearance, but are distinguished by the persistent, globose capillitium, the columella, and the smaller spores.

10. PHYSARUM GYROSUM Rost. The species was found at Manhasset as far back as 1923, and since then five more collections have been made, so that it is not rare. The colonies are large, extending over twigs, stems, leaves, etc., usually on rubbish piles, and once on the grass of a lawn. It is probably far more common than recorded, and as it resembles plasmodiocarpous phases of *Physarella oblonga*, may easily be mistaken therefore. The internal lime is white, not yellow like in the latter species. In most of our collections the prevailing tints are bluish, not pink. June to September.

11. PHYSARUM LATERITIUM (Berk. & Rav.) Morgan. The normal form, with scarlet lime in the walls of the sporangia and short plasmodiocarps, is frequently collected and therefore not rare. It is remarkedly constant, varying only in the number of the calcareous nodes of the capillitium, sometimes numerous, again few, but always rounded and with the reddish centers.

We have another phase, that was found in July of one season at Albertson, in numerous fruitings on leaves, and this is placed here tentatively. It has the same habit as the other, but the color is yellowish-brown, due to the presence of yellow lime gran-

ules in the brown wall. The lime-knots in the capillitium are large, angular, and branching, not rounded. The spores are violet-brown, 9–10 μ diam., and distinctly warted; larger, darker, and rougher than in the scarlet form. It may be intermediate with *Physarum virescens,* or, if the production of hybrids is established, may be a hybrid between the two species. I have a firm conviction that hybrids occur, as this is the only way in which to explain the occasional occurrence of certain forms at long intervals. July to September.

12. PHYSARUM MELLEUM (Berk. & Br.) Massee. Common and collected almost every season on leaves, twigs, etc. July to September.

13. PHYSARUM MURINUM Lister. Closely allied to *P. globuliferum,* but differing in the color of the lime in the wall and capillitium. In typical examples, this is brown, but shades to pale yellow, when, the separation of the two species is difficult, and mainly a matter of personal opinion as to where the line should be drawn. The color of the lime is constant throughout the same colony, and we have found generally that the darker colored forms are in small colonies. We have many collections of the typical and intermediate forms. June to September, on wood.

14. PHYSARUM NOTABILE Macbr. Following a strict interpretation of the rules of nomenclature, the foregoing name, as proposed by Macbride, should displace *Physarum connatum* (Peck) Lister, as the latter is in use already as a synonym, twice over. Also, the Lister description of *P. connatum* is more restricted, which was apparently recognized by Macbride in broadening the description of *P. notabile* to include *P. connatum* and some other American forms that belong here, but cannot be satisfactorily placed under the Lister description.

Closely allied is *Physarum leucophaeum* Fries, which Macbride considers as a distinct species, and Lister regards as a variety of *Physarum nutans* Pers., with somewhat differing interpretations. The entire group, with some others, overlap and vary so much that they have always been a puzzle to students and will likely continue to be, as there are no sharp lines of demarkation, except in certain cases.

Lister regards *P. connatum* as a strictly stipitate form, with a stalk free from lime or with lime in the wall only, the tube enclosing refuse matter. The spores are described as purple-brown, spinulose, and 10–11 μ diam. We have two collections, from the Deer Park forest, that agree perfectly with this description, and are disposed of quickly. Another collection from the Wheatley Hills, has sessile, globose sporangia, in all respects superficially like others discussed here. The capillitial lime is similar, but the spores are not as dark as those in the Deer Park specimens and measure 12–14 μ. While an October fruiting, it is perfectly mature and regarded as a phase of the present species with larger spores, there being no stalks, or compressed sporangia, to indicate that it is *Physarum compressum.*

The greatest variation occurs among a dozen or more collections from the Mill Neck swamp, half of which were successive fruitings on the same log in one season, with every reason to consider them as reappearances of the same species. The sporangia of these collections are stalked or sessile, sometimes within the same colony. All have much lime in the capillitium and resemble *P. connatum* except in the stalks and spores. None have any characters that would indicate affinity with *Physarum leucopus, Physarum compressum, Physarum globuliferum,* or any other *Physarum* of the white lime group. The stalks are solidly calcareous in some colonies, limeless or almost so with enclosed refuse matter in others, and again have lime only in the wall externally. The spores range in color from dark purple-brown, through lighter shades with a tinge of gray, to clear violet-brown, which latter prevails in most of the collections. The spores are always distinctly spinulose, and measure 8.5–9.5 μ in the majority of cases, and in the others up to 12 μ, with a range of only 1–1.5 μ in the spores from the same colony. To use a process of elimination, including in *P. connatum* those forms with one or more applicable characters as given by Lister, and then placing the remaining ones with *Physarum nutans* var. *leucophaeum* or var. *robustum,* as the only places left with fittingly described characters, seems to me an absurd way of handling the situation. These forms have no relationship to *Physarum nutans* whatever. From a study of the fruitings in the field, and, having no specimens from

Long Island to show that the mentioned varieties of *P. nutans* occur here, I am convinced that all the present forms are phases of *P. connatum* or rather *P. notabile*. They are so regarded, with the suggestion that sessile sporangia, the variable stalk, and the variations in spore size and color, have not been given sufficient consideration heretofore in descriptions of this extremely variable species.

15. PHYSARUM NUCLEATUM Rex. Common throughout the season, in fairly large colonies of several hundred sporangia. It occurs on wood or on ground matter. The species is well differentiated, and distinguished from *Physarum globuliferum* by the non-calcareous stalk, the absence of a columella, and the central ball of lime in the capillitium. Another character, not often mentioned, is that the sporangial wall is thickened at the base, persisting as a circular plate at the top of the stalk, to which the capillitium is firmly attached. This thickening is clearly shown on the outside of the sporangia in all of our material.

A phase of *P. nucleatum,* frequently found here, has much smaller sporangia on stalks as long as in the normal form. The central ball of lime is often missing and replaced by larger lime-knots in the capillitium. The circular plate at the base of the sporangium is always present, sometimes as a fairly well defined cup. I regard this as an erratic phase, abnormally developed, under adverse conditions. It must not be confused with *Physarum pusillum,* which is entirely different.

16. PHYSARUM NUTANS Pers. Typical specimens are not common, as it has been found only six times in all of our collecting, and I doubt that it is so abundant elsewhere as often stated. We make many collections with white sporangia and apparent white lime-knots, but the latter when observed by transmitted light with the microscope are seen to be pale yellow in color. Such are not *P. nutans,* but are *Physarum viride* var. *incanum*. *P. nutans* should not be determined hastily on appearances with reflected light. Occurs on wood, July to September.

17. PHYSARUM OBLATUM Macbr. The form as we have found it at Mill Neck, on bark and regarded as typical, is practically the same as the globose form of *Physarum pusillum,* figured by Lister on pl. 43 of the Monograph, except that the capillitial lime is yel-

low, and the spore punctuation is uniform and not grouped in patches. We have a smaller form on dry, dead, stems and sedges from Jones Beach which is *Craterium Maydis* Morgan and placed by Torrend in *Physarum* as *P. Maydis.* There are no characters to distinguish the two forms, except habitat and size, and as there is hardly room for two species, Macbride's name, having priority, is recognized for both. July and September.

18. PHYSARUM PENETRALE Rex. We have but a single collection made at Mill Neck in June. The sporangia are yellowish in color, ellipsoid in shape, on slender, red, translucent stalks, which are curved where they enter the sporangia, and penetrate almost to the top.

19. PHYSARUM POLYCEPHALUM Schw. Collected at Great Neck during three seasons on the same log with *Physarella oblonga;* also at Albertson on leaves in wide spreading developments. The original color of the sporangia is yellow, which fades rapidly to gray. As noted by others, var. *obrusseum* is no more than a phase and appears throughout the collections of clustered sporangia. July to October.

20. PHYSARUM PULCHERRIMUM Berk. & Rav. Two collections on wood, both in August. Related to *Physarum globuliferum,* but with purplish-red color.

21. PHYSARUM PUSILLUM (Berk. & Curt.) Lister. The Lister interpretation of this species includes two forms figured on pl. 43 of the Monograph, which are so far apart in external appearance, lime, and spores, that when placed side by side, they appear to be different species. Perhaps they are. The typical form bears a striking resemblance to *Didymium xanthopus,* superficially, but of course is a *Physarum.* The sporangia are small, depressed globose or lenticular, with a concave or flattened base. The lime in the capillitium, while varying in different collections, is not dense. The spores in all sporangia are uniformly warted, not in patches. This form is common, and often collected on straw, leaves, twigs, etc.

We have a fine development of the other form on wood. The sporangia are twice as large as in the typical form, and are globose, not flattened or concave below. The capillitium is dense with lime, almost Badhamia-like, and the spores have from two to

four patches of clustered warts on the hemisphere, among the other warts. The red stalks and reddish bases of the sporangia are alike in both forms, This globose variety looks like *Physarum oblatum,* only that the lime of the latter is yellow, and when this is faded, the two are indistinguishable except for the spore differences. Throughout the season.

22. PHYSARUM RUBIGINOSUM Fries. This rare species has been found three times on leaves in August and September, but in very small fruitings. One of the collections has scarlet sporangia, with similarly colored, large, branching lime-knots. In another, the wall is almost limeless, and the lime in the capillitium is brown.

23. PHYSARUM SINUOSUM (Bull.) Weinm. This cosmopolitan species occurs on leaves, in great abundance throughout the season.

24. PHYSARUM TENERUM Rex. We have nine gatherings of the species, so that it is not rare. In most of them the sporangia are almost white, but the numerous, rounded, yellow, lime-knots; the long, yellow stalks, which are darker at the bases; and the missing columellae, distinguish the species. The stalks are usually sharply bent or twisted at the tops, which character separates the form from certain phases of *Physarum nucleatum,* when other characters are not well defined. On wood in small colonies, July and August.

25. PHYSARUM VARIABILE Rex. The typical, stalked form has not been found, but two collections of var. *sessile* Lister have been made, each on leaves in August, and at stations separated by miles. The walls of the sessile sporangia and plasmodiocarps have yellow, orange or reddish colored lime, but the capillitial lime is white or almost so. The spore size is 7–8.5 μ.

This variety has had a checkered taxonomic career. Known to students by the name here applied, a similar form was elevated to specific rank by Brandza as *Physarum sessile.* Miss Lister, in the 3rd edition of the Monograph, regards *P. variabile* as a phase of *Physarum sulphureum* Alb. & Schw., accepting *P. sessile* as a separate species, and including with the latter the sessile sporangia and plasmodiocarps formerly regarded as var. *sessile* of *P. variabile.* It should be remembered that *P. sulphureum* is generally regarded as a stipitate species, and that sessile sporangia are frequently

present in collections of typical, stipitate *P. variabile*. Now later, Brandza divides his *P. sessile,* retaining the name for forms with white lime in the walls and capillitium, and proposes the name *Physarum aureum* for those with yellow lime. Our forms cannot be fitted with the descriptions of either of Brandza's species, by lime color or spore size, nor is it agreeable for me to stretch a point and attempt it, as I am inclined to believe that later study of further collections will indicate that all forms under discussion are phases or varieties of the same species. If that be so, *P. sulphureum* has priority, and the description of the species must be broadened. Until more light appears, I am calling our forms by the name that they have carried for years, feeling there is still enough uncertainty about uniting *P. variabile* with *P. sulphureum,* and also, that Brandza's later names may be superfluous when the confusion clears.

26. PHYSARUM VIRESCENS Ditmar. The species was collected several times in one season, at various stations on leaves, and once again the third following season. The typical form with heaped, yellow or greenish, sporangia, does not differ materially from heaped phases of *Physarum cinereum,* except in color. Var. *nitens* Lister was found once on leaves at Albertson. The bright yellow sporangia and short plasmodiocarps are separated, not clustered, and show a resemblance to *Physarum lateritium,* with which it appears to be intermediate. July and August.

27. PHYSARUM VIRIDE (Bull.) Pers. The species is abundant throughout the season, generally in the typical form or the var. *incanum.*

Var. *aurantium* (Bull.) Lister has been found twice. The color is orange, but not as dark as in specimens from other localities.

In September 1927, we found at Mitchell Field, a fruiting of typical *P. viride,* which at one end gradually merges into robust sporangia, on stout stalks, with densely calcareous peridia, and abundant yellow lime in the capillitiums. Specimens were submitted to Dr. W. C. Sturgis, who has made a study of var. *Bethelii* (Macbr.) Sturgis, and he advises me that they undoubtedly represent the variety. However, it is no more than a variety, as the gradual merging into the typical form indicates clearly that all

sporangia in the fructification have developed from the same plasmodium.

Var. *incanum* Lister is abundant and has gray or white sporangia, showing occasionally a trace of yellow, and with pale yellow lime-knots. In my opinion it is a hybrid between the typical, yellow form of *P. viride* and *Physarum nutans*. Some years ago, we found at Albertson a fructification of thousands of perfectly matured sporangia, covering an area of between two and three square feet. Only part of the fruiting was taken, and for several years, on every occasion when visiting the locality, the particular spot was examined. No further developments appeared nor anywhere in the immediate vicinity. Among the sporangia of that part of the colony removed, there are many with confluent stalks, and others that are compound. The compound sporangia are on stout stalks showing no signs of merger, and dividing about halfway up into as many as four branches, each supporting a perfectly matured sporangium. Also, among these sporangia of var. *incanum* there is a group of about a hundred sporangia, half of which are typical *P. viride*, of deep yellow color and yellow lime-knots, and the other half are typical *P. nutans*, with white sporangia and white lime-knots, the sporangia intermingled, adjacent, and alike except in color. Within this group there is another interesting feature. There are compound sporangia, as previously mentioned, which carry on different branches, white and yellow sporangia. In other words, *P. nutans* and *P. viride* have developed on the same stalk. The latter clearly indicate that all three forms in the colony have developed from the same plasmodium.

This remarkable development almost proves either of two theories. The first is, that *P. viride* and *P. nutans* are not separate species, but develop from the same plasmodium, the color depending upon unknown, varying, conditions. The other, that the colony came from a hybrid plasmodium, and that the two species are distinct. I incline to the latter view which is strengthened by the non-appearance of the form after its first collection, indicating perhaps, that the spores were sterile. Also, such occasional occurrences in other species have been observed and referred to in this paper. If the theory of hybridism should be absolutely dis-

proved, however, there is no other conclusion but that *P. viride* and *P. nutans* are phases of one and the same species.

31. RETICULARIA Bull.

A monotypic genus closely related to *Enteridium*.

1. RETICULARIA LYCOPERDON Bull. The aethalia, when small, are often similar in appearance to those of *Enteridium Rozeanum*, and difficult to distinguish without blowing out the spores and examining the capillitium. In this species the capillitium is free from the silvery-white cortex, and more thread-like at the top. In *E. Rozeanum*, the perforated, flattened pseudo-capillitium is attached to the brown cortex at many points. If a part of the cortex is raised and shows the perforated plates, the aethalium is that of *E. Rozeanum*. Another character of *R. Lycoperdon* is the rapid germination of the spores. In fresh, fully matured, material, this takes place in less than one hour, so that the species may be identified thereby, as in no other slime mold is the germination so rapid.

The species is found here occasionally in small single aethalia, but is not common. We have two fruitings of large aethalia, in one of which there are several aethalia up to 5–7 cm. across. The last mentioned collection has spores in large, loose clusters. The plasmodium is said to be white. In the last mentioned collection it was dark purplish before fruiting. Occurs May to October.

32. STEMONITIS Gleditsch

The genus presents problems in classification. Three well marked centers are seen; *S. fusca*, *S. splendens*, and *S. axifera*. Around each are grouped a number of forms, some of which are generally regarded as of specific rank, and others treated as varieties. The latter varietal forms are frequent in North America, and in most instances so different, that they can be recognized with a hand lens. While it is true that they are more or less related to one or other of the three species mentioned, it is also true that such relationships are frequent throughout the Mycetozoa, and it is mainly a matter of personal opinion whether or not to regard them as distinct species. *Stemonitis* is a difficult

genus to study, and dividing it into more species with full descriptions, instead of short varietal notes, will do much to help the student to a better understanding of the genus. As a matter of convenience, I am reporting as specific those forms found on Long Island which are regarded by the Listers as varietal, agreeing however, that their position as such is not fully established.

The genus is well represented on Long Island. The one outstanding feature is, that the spores in many species are small, frequently of less diameter than the smallest sizes mentioned in descriptions.

1. STEMONITIS AXIFERA (Bull.) Macbr. The species is common and occasionally in large fructifications of many clusters. The rusty color, fine meshed surface net, and small spores, serve to distinguish it. The spores in almost all of our material are less than 5 μ diam. The plasmodium is white. Occurs throughout the season, on wood.

2. STEMONITIS CAROLINENSIS Macbr. Easily recognized, but apparently only a phase of *Stemonitis pallida*. The members of the group to which it belongs are so closely related and interwoven, that allowances must be made for slight differences. Our one undoubted specimen has spores that measure 4.5–5 μ, a permissible variation. On wood, June.

3. STEMONITIS CONFLUENS Cooke & Ellis. The plasmodium, in fructification, breaks into numerous parts, forming as many as thirty to forty small clusters of dark, confluent, sporangia. The clusters vary from 1 to 20 mm. across. We have three collections on wood. September and October.

4. STEMONITIS FENESTRATA Macbr. The form may be recognized in the field with the unaided eye by one familiar with its features, because of certain peculiarities of habit and appearance at different stages of maturity. The almost complete absence of connecting threads between the columella and surface net seems to set it out as a center sharply away from *Stemonitis splendens*. The eccentricity of the columella along the net, and the loosely, spiral ascent, are of minor importance, as such features are noticeable, in a lesser degree, in other species with a lax, inner capillitium. They are due to a twisting of the entire sporangium during drying and spore dispersal, and are more emphasized after

complete desiccation. The form is often found and usually in large fruitings. On wood throughout the season.

5. STEMONITIS FLAVOGENITA Jahn. While critically studying a large number of collections of the small-spored phase of *Stemonitis herbatica,* mentioned under that species, a specimen was found having several small clusters of sporangia, with pale, ferrugineous spores, 9 μ diam. The sporangia are 5 mm. tall, and on short stalks of 0.8 mm. The columella has the membraneous cap at the apex, and the capillitial threads have many broad expansions with a delicate, spinose, surface net. It is typical *S. flavogenita.* The species has probably been overlooked heretofore in the field, as it bears also a superficial resemblance to *Stemonitis Smithii.* The small species of the genus, *S. flavogenita, S. Smithii, S. herbatica, S. hyperopta, S. pallida* and *S. virginiensis,* all resemble each other externally, so that careful microscopical examination is necessary in order to separate them. On leaves, July.

6. STEMONITIS FUSCA Roth. If the given spore diameter of 8–10 μ is accepted, typical *S. fusca* is certainly very rare on Long Island. We have numerous collections of the species, as it is common and abundant, and in all but one or two of fifty or more examined, the spores ranger from 6–7.5 μ, no matter what the color of the sporangia or spores may be. There is nothing in the description of var. *rufescens* Lister to distinguish it from phases of the typical form, except the smaller spore size given as 5–8 μ. Any emphasis laid upon the faintness of spore markings is of little importance as it is quite natural that smaller spores should be more faintly marked than larger ones, and as a matter of fact, it is usually the case. Small sized spores are the rule in many of the species of *Stemonitis* from Long Island, and it is evident that spore size is an inconstant factor here. I am regarding all our collections as typical *S. fusca.* There is a wider range in the spore size of *S. fusca* than heretofore believed, with no necessity for separating as varietal any forms with small spores.

The species is also unique in having spores of two distinct tints, pronounced in extreme cases when observed side by side. About half of our material has grayish-violet spores, by transmitted light. The remainder are rufous or brownish-violet. Intensity of color depends much upon the size of the spore, and this should always

be remembered in estimating spore color by transmitted light. Other conditions being equal, a small spore will be paler than a large one. A parallel may be seen in thick and thin pieces of glass, colored alike, and held against the light. The thick one may be dark or opaque; the thin one, translucent.

Several of our collections have the imperfect capillitium and surface net of var. *flaccida* Lister. The species is found throughout the season, on wood.

7. STEMONITIS HERBATICA Peck. The species exhibits some variation in the size of the sporangia and shape of the clusters, as well as in microscopic characters. It must be regarded as a convenient center, covering a number of forms with variable characters, which if fruiting on leaves, are well named. When the development is on wood, the approach to any other particular species is not always seen clearly. The forms we have on wood, have more or less the pallid surface net of *Stemonitis pallida,* and are regarded as closer to that species, ignoring the shape of the meshes of the surface net, which are more angular as in *S. herbatica.*

In the Albertson kettle hole, there occurs annually a small phase of *S. herbatica* about 5 or 6 mm. tall, developing on leaves in numerous, small clusters of almost erect sporangia. It has also been observed in several other places. The surface net is usually normal with angular meshes, again more irregular as in *S. pallida,* but without the pale color of the latter. The spores, invariably, are from 4.5–5 μ, and very constant in the size. There is nothing otherwise to distinguish the form from *S. herbatica,* and recalling the tendency to form small spores in many of the species of Stemonitis here, I do not regard it as more than an interesting phase. The normal, larger, form with larger spores, is also frequent throughout the season.

8. STEMONITIS HYPEROPTA Meylan. The form looks like a small *Comatricha typhoides,* in the pale, lilac-brown color, and has the habit of *Stemonitis Smithii* in the few, small, clusters of sporangia to the colony. The capillitial net is sometimes almost perfectly developed, but more often lacking in the upper half. The spores do not have the few, large, warts present on the spores of *C. typhoides,* and instead are faintly or obscurely reticulated. It

is not common, but has been collected a number of times on wood from June to September.

9. STEMONITIS PALLIDA Wingate. The statement in the Lister Monograph, that the spores assume a coffee bean shape when dry, should be disregarded, as such effects are seen with spores of many other species, including those allied to *S. pallida*. The separation of the species from *Stemonitis herbatica* is often perplexing, but if the fruiting is large enough, the habit of forming many small groups, consisting of from two to twenty-five erect sporangia, and the pale, almost hoary, color of the sporangia, when blown out, are characteristic. The surface net is uneven, not only in the plane of the net, but also extending away from it, so that the edge view appears irregularly sinuose. This is seen occasionally in *S. herbatica,* but the tendency there is to form a more even net with regular, polygonal meshes. The spores in our specimens are from 6.5–7.5 μ, faintly spinulose, and much like those of *S. herbatica.* We have about a dozen collections, always on wood, the majority of which are typical, the others merging into *S. herbatica.*

10. STEMONITIS SMITHII Macbr. There is nothing of importance to separate the form from *Stemonitis axifera,* except the smaller size of the sporangia, which are up to 6 mm. tall. Minor differences, sometimes regarded as characteristic, are not constant and found also in the larger forms. We have numerous collections, each consisting of a few, small, clusters of sporangia. In moist chamber experiments, sporangia developed from a plasmodium which was greenish yellow, when extended, and dull green, when contracted. *S. Smithii* may be only a variety of *S. axifera* as the Listers regard it.

11. STEMONITIS SPLENDENS Rost. Common on wood throughout the season, and often in large fructifications.

12. STEMONITIS TRECHISPORA Macbr. Certain developments of this species are undoubtedly close to *Stemonitis fusca* in anatomical characters, but in the features of its habitat and habit it is so different that there is no doubt in my mind about its distinctness, and that its plasmodium will not produce typical *S. fusca.* If those features are unknown or ignored, it is impossible in many instances to distinguish between the two species.

The form occurs here in great abundance, at times, and we have had as many as forty or fifty fruitings within view at one time in the wet swamps. The plasmodia are milk-white after emergence, and inhabit the ground substratum, not wood as in *S. fusca*. The plasmodia do not travel, but fruit where they emerge, and frequently close to the water's edge, resulting in many poorly developed or aberrant phases with unusual variation. Molds form rapidly in the moist situations; small beetles find the spores palatable and ravage the sporangia; and as the developments are loose, fluffy, and fragile, little is left after a day or so except dark patches on the ground. This accounts for the infrequent reporting of collection in quantity. The small beetles that are found with *S. trechispora* do not infest *S. fusca*, which would indicate a toxicological factor there.

In perfect developments, and many are so, the sporangia are free, nowhere confluent, although closely compacted in clusters up to 3 cm. across. The weak, recumbent stalks are about one-quarter the total height, which is about that of *S. fusca*, and the color of the sporangia is black. The columella is weak, often twisted, and the capillitium and wide-meshed surface net are often imperfect. The spores are dark purplish-brown, range from 8.5–12 μ, and are reticulated with raised bands, continuous or broken, or reticulated with spines. In other developments the sporangia are more or less confluent, more so at the bases, occasionally assuming a pseudo-aethaloid shape with almost even surface, and suggesting *Amaurochaete*. These forms all come from similar plasmodia developing the most irregular, variable, aberrant species, that it has been my good fortune to observe closely and frequently in the field. June to September.

13. STEMONITIS VIRGINIENSIS Rex. A single collection from Albertson in June is on wood. The spores are typical, coarsely reticulated with continuous, narrow, raised bands. The color of the spores is pale lilac-brown, and the size 6.5–7.5 μ.

14. STEMONITIS WEBBERI Rex. The form has been found on wood, on three occasions at Jones Beach only. It is undoubtedly close to *Stemonitis splendens*, but readily distinguished by the open capillitium and large meshed surface net. If development is always under unusual conditions, as here at the seashore, it is prob-

ably no more than an abnormal phase of *S. splendens*. With one fruiting, a light yellow plasmodium was noted.

Stemonitis splendens var. *flaccida* Lister belongs with *S. Webberi* if the latter is regarded as a species. Two collections, also from Jones Beach, are clearly degenerate phases. Martin and Macbride refer to the form under *S. splendens* var. *flaccida*, and again as *Comatricha flaccida* (Lister) Morgan.

33. TRICHIA Haller

All of our Long Island *Trichiae* are on wood, and found to best advantage in the autumn months when *Trichia varia* and others appear in great abundance. The differences between *Trichia* and *Hemitrichia* being principally in the character of the capillitium, there are several species in each genus that are similar to others in the opposite genus, with the exception of the capillitium. Forms are occasionally found among species of *Trichia* that have a partially netted capillitium, and then other characters, particular to the species, must be considered in order to identify them.

1. TRICHIA AFFINIS de Bary. The species is maintained as a center between *Trichia favoginea* and *Trichia persimilis*, differing from the former in having spores with broad, pitted bands, yet forms occur with narrow bands, and when the width of the elaters does not exceed 6 μ, are regarded here as the present species. When the elaters are wider, and the sporangia are cylindrical or ovoid in shape, the approach is towards *Trichia favoginea* and they are so regarded, notwithstanding the pitted character of the bands. Little of the extensive collections from Long Island of *Trichia affinis, Trichia persimilis* and *Trichia pulchella* is typical as regards the spores. The three forms cannot be separated definitely otherwise than by the spores, and these vary in their sculpturing from broad, pitted bands, through narrow, pitted bands, to a broken reticulation or pitted warts. These variations are found in fruitings taken from the same wood, year after year; in the same colony; and sometimes in the same sporangium. It is logical to assume that such variations do not come from any qualities inherent in the plasmodium.

A species should bring to a common center as many forms as possible, having similar characters. To maintain several centers

on an inconstant character like the spore sculpture of these forms, when all other characters are almost identical, does not clarify the taxonomy, and leaves too many intermediate and indeterminate forms. *Trichia favoginea,* with broad elaters and narrow, continuous bands on the spores is well marked. All other forms here mentioned should be regarded as phases of *T. persimilis,* the first published name. To do otherwise is to sanction the proposal of new species on trivial grounds, which practice should be discouraged.

2. TRICHIA ALPINA (R. E. Fries) Meylan. This species is rare except in Alpine regions. We have a small collection that agrees fairly well with specimens received from Dr. Meylan. The wall is thick, dense with granules, and black. The sporangia and plasmodiocarps spread at the bases where attached to bark on which they were found, and have an appearance of imperfect maturity externally, although the capillitium and spores are properly matured. The same feature is noticed in the Swiss specimens. The spores in our specimen measure 12–15 μ. September.

3. TRICHIA BOTRYTIS (Gmel.) Pers. The two collections that we have are not typical, the capillitiums consisting mainly of very long elaters, somewhat branched and netted, although short, free, elaters are present. Miss Lister, who has examined one of them, regards other characters as indicating *T. Botrytis.* August and October.

A dozen sporangia on a dry, leaf stem are regarded as var. *flavicoma* Lister. They are small, 0.3 mm. diam., on short, stout, black stalks. The peridium is purplish-brown with yellow lines of dehiscence. The profuse capillitium has free, yellowish elaters, 2–2.5 μ wide, ending in fairly long, slender points. The elaters are not straight, but irregularly sinuose, and the spirals are faint. Spores yellowish, almost smooth, 9.5 μ.

4. TRICHIA CONTORTA (Ditmar) Rost. Only one collection, which is typical, with uneven, irregular spirals on the elaters. Found in May, but evidently a prior season's fruiting.

5. TRICHIA DECIPIENS (Pers.) Macbr. Found, not rarely, durthe *Trichia* season in October and November. We have one gathering with convex lids breaking away in sharp, circular fashion, which is var. *olivacea* Meylan. Another fruiting of small,

scattered sporangia, otherwise normal, was taken from the bark of a living tree.

6. TRICHIA FAVOGINEA (Batsch) Pers. Not common, but found occasionally during the late autumn. There is some variation in spores and capillitium among our collections. The sporangia of one have elaters with blunt, truncate ends as in *Oligonema,* although otherwise normal. In all, the thickness of the elaters is from 6–7 μ, and the spore borders are about 1.5 μ. In several gatherings the spores have broader, pitted bands, with spores among them that have narrow, non-pitted bands. These approach *Trichia affinis,* but other characters are those of *T. favoginea.* The ovoid or cylindrical sporangia distinguish the species from other allied species of *Trichia* except *T. affinis.*

7. TRICHIA FLORIFORMIS (Schw.) G. Lister. A beautiful form when fully matured, having some resemblance to *Hemitrichia vesparium.* Sessile sporangia also occur as in the latter species. *T. floriformis* seems to fruit here only once a year, and developments on the same log, in three successive years, have appeared almost to a day. It is one of the species that are very slow in development of the sporangia, the process requiring from seven to fourteen days until complete maturity. We have it from three other stations so that it is not rare.

8. TRICHIA INCONSPICUA Rost. The species differs from *Trichia contorta* in no more important feature than the more perfect symmetry of the elaters of the capillitium. It seems to be a more highly perfected phase of the latter, or rather, *T. contorta* is an imperfect phase of *T. inconspicua.* There is no difficulty in distinguishing the two, and, while it may be better to combine them as a single species, the same may be said of a number of other species, that have been accepted by students on less prominent differences in characters. Three collections on wood, September to December.

9. TRICHIA PERSIMILIS Karst. Specimens with typical spores are not common among our collections. In much of the material, the reticulations approach more nearly those on the spores of *Trichia affinis,* but this is inconstant, varying sometimes in the same sporangium. In moist chamber experiments, sporangia de-

veloped from a yellow plasmodium. Found throughout the season, from June, which applies also to the allied species.

10. TRICHIA PULCHELLA Rex. This is no more than an intermediate form between *Trichia persimilis* and *Trichia affinis*. The three, when forming globose sporangia, are practically identical except for the banding of the spores. In *T. pulchella*, the bands of the reticulations are narrow and pitted, but all sorts of variations are found, from broken reticulations to broader bands. *T. persimilis* and *T. affinis* are so close, inseparable at times, that it is needless to maintain another species between them. *T. pulchella* is frequent in the joint material of the three forms mentioned. The spirals on the elaters, in our material, wind as a left-handed screw; not right-handed as in the figure of Macbride and Martin.

11. TRICHIA SCABRA Rost. The species is similar to *Trichia persimilis* in the sessile, globose sporangia and crowded habit. Usually it can be distinguished in the field by the darker, orange color, and the larger size of the colonies. In both species, the capillitium is usually, but not always, studded with spines. The spores are entirely different and diagnostic. It is common, as early as June, but more abundant in October and later.

12. TRICHIA VARIA Pers. An extremely variable form as the name implies. We have globose, ovoid, and turbinate sporangia, on stout, black, stalks; also, sessile sporangia and plasmodiocarps, the latter up to 15 mm. long. The color ranges from ochraceous-yellow to olivaceous. The species is readily determined by the presence of only two spirals on the elaters, all other Trichias having three or more. The spirals wind like the threads on a left-handed screw, not right-handed, as the figure in Macbride and Martin is drawn. Abundant in October and November.

34. TUBIFERA Gmelin

A very interesting genus. The three species, recognized as fairly well marked centers when characters are clearly shown, are connected by many intermediate forms and gradually merge into each other. The columellae in *Tubifera Casparyi*, in the best developments, show a resemblance to those in *Stemonitis* and *Comatricha*. On the other side, pseudoaethalioid forms of *Tubifera*

ferruginosa are often so closely compacted, and with degenerate sporangial walls, as to hint a relation to *Enteridium* and *Lindbladia*. It is possible that with further study, a line of transition may be traced from certain species of *Stemonitis* or *Comatricha* to *Cribraria*, through *Tubifera*, *Enteridium* and *Lindbladia*.

1. TUBIFERA CASPARYI (Rost.) Macbr. A collection from the Deer Park forest shows a fine development of the columellate structure, in many of the sporangia. In other collections, there is only a mere trace, here and there in a few sporangia, and not sufficient to regard them as distinct from *Tubifera ferruginosa*. It is hardly more than a variety of the latter, in fact in much of our better material, with well defined sporangia, there is a tendency in *T. ferruginosa* to show columellae occasionally, either *Stemonitis*-like or hollow.

2. TUBIFERA FERRUGINOSA (Batsch) Gmelin. The species shows much variation in shape, from almost free sporangia, connected at the bases only and not confluent, through many stages to aethalioid-like masses with imperfectly developed sporangial walls. In such cases the tops of the confluent sporangia are flat; in the freer sporangia, conical or convex. In collections with convex caps, which are often perforated, the hollow columellae are frequently found, but in only few of the sporangia. They arise from the base within, or diagonally from the sides, or again from the cap at the perforation and then leading downwards. They are the pouch-like protuberances mentioned by Lister, and different from the long, *Stemonitis*-like columellae, with side processes to the walls, which are characteristic of *T. Casparyi*. Forms with such protuberances should be regarded as phases of *T. ferruginosa*. Occurs on wood, from June to November, and common.

3. TUBIFERA STIPITATA (Berk. & Rav.) Macbr. Practically the same as *Tubifera ferruginosa* except that the cluster of sporangia is seated upon a stout, spongy base, somewhat like a stalk, and varying in height. In our typical collections the spores are smaller than in *T. ferruginosa*, never over 5 μ, and there are no tendencies towards the columellate structure of *Tubifera Casparyi*. It is not common, our best specimens coming from the Albertson kettle hole, at the time that the allied species are fruiting.

ADDENDA

Three additional species are reported as occurring on Long Island. These appeared, as moist chamber developments, on dead oak and cottonwood bark collected in the late season of 1935, near Mitchell Field.

COMATRICHA FIMBRIATA G. List. & Cran. This minute species is almost impossible to detect in the field. We have watched the moist chamber sporangia develop under the microscope, and as soon as they commence to dry, the spores are catapulted away from the delicate tuft of capillitium, which often disappears, leaving only the bare stalks. The habit is scattered—a sporangium here and there—and usually along the crevicies or outer edges of the bark. The developments on oak bark are typical.

ECHINOSTELIUM MINUTUM de Bary. An extremely small form, with a habit like *Comatricha fimbriata,* and practically impossible to find except by careful search with the microscope. The sporangia resemble those of a common *Mucor,* but the latter have shorter stalks, and are in densely aggregated colonies. The spores in *E. minutum* are globose, not ellipsoid as in the *Mucor*. *E. minutum* also developed in a moist chamber on wood collected at Sheds, Madison Co., New York.

KLEISTOBOLUS PUSILLUS Lipp. This forms small but numerous sporangia, so that the colonies can be seen with a hand lens. The sporangia are subglobose, bright brown in color, with convex, shining, lids, which are depressed below the rims of the sporangia. We have collected natural fruitings of this species and *Hymenobolina parasitica* Zukal at localities near Ithaca, New York, and there is little superficial resemblance between them. The last named has also many sporangia, but larger and of a dull, dark color—almost black—which makes them difficult to differentiate from the lichens on which they developed. *H. parasitica* did not develop on Long Island wood, but *K. pusillus* appeared in several developments on oak and cottonwood bark collected at Mitchell Field. The distinctions between the two species are hardly more than specific, and they might well be placed in one genus together with *Orcadella operculata* Wing., which differs materially only in the presence of a stalk. All are closely related to *Licea,* differing by the presence of a distinct lid or operculum.

THE NEW YORK BOTANICAL GARDEN

INDEX TO VOLUME XXVIII

INDEX TO AUTHORS AND TITLES

Andrus, C. F. Cell relations in the perithecium of *Ceratosto... multiannulata* 133

Bitancourt, A. A. & Jenkins, A. E. Perfect stage of the sweet orange fruit scab fungus 489

Blank, I. H. & Tiffney, W. N. The use of ultra-violet irradiated culture media for securing bacteria-free cultures of *Saprolegnia* 324

Brandriff, Helen. The development of the ascocarp of *Acrospermum compressum* 228

Buchwald, N. F. & Whetzel, H. H. North American species of *Sclerotinia* and related genera. III. *Ciboria acerina* 514

Burlingham, G. S. New or noteworthy species of *Russula* and *Lactaria* 253

Cash, E. K. Some ascomycetes new to California 247; Some new Colorado discomycetes 297

Charles, V. K. The synonymy of *Botrytis Rileyi* Farlow 397

Christenson, L. D. & Taubenhaus, J. J. Insects as possible distributors of *Phymatotrichum* root rot 7

Cummins, G. B. Phylogenetic significance of the pores in urediospores 103

Davidson, R. W. & Shear, C. L. The life histories of *Botryosphaeria melanops* and *Massaria Platani* 476

Dearness, John. Reliquiae Kauffmani 209; The Mycological Society of America 98; Note on the distribution of fungi 495

Diehl, W. W. *Helvella palustris* in Virginia 89

Dodge, B. O. *Schizoparme straminea* and *Nectriella Versoniana* identical 95; Spermatia and nuclear migrations in *Pleurage anserina* 284; Facultative and obligate heterothallism in ascomycetes 399

Drechsler, Charles. A new species of *Stylopage* preying on nematodes 241; New conidial Phycomycetes destructive to terricolous Amoebae 363

Edgerton, C. W. & Johnson, H. W. A heart rot of *Magnolia* caused by *Fomes geotropus* 292

—— & **Plakidas, A. G.** A new imperfect fungus 82

Fitzpatrick, H. M. The Mycological Society of America report of the fourth annual meeting 197

Graff, P. W. North American polypores—I. *Polyporus squamosus* and its varieties 154

Groves, J. W. *Ascocalyx Abietis* and *Bothrodiscus pinicola* 450

Hagelstein, Robert. A critical study of the Mycetozoa of Long Island 547

Hatch, W. R. Zonation in *Allomyces arbuscula* 439

Hotson, J. W. The Amanitae of Washington 63; A new species of *Arachniotus* 497

Jenkins, A. E. An undescribed species of *Taphrina* on chinquapin 31

—— & **Bitancourt, A. A.** Perfect stage of the sweet orange fruit scab fungus 489

Johnson, A. G. & Sprague, Roderick. A new *Pseudodiscosia* 181

Johnson, H. W. & Edgerton, C. W. A heart rot of *Magnolia* caused by *Fomes geotropus* 292

Jones, P. M. A new species of *Microascus* with a *Scopulariopsis* stage 503

Kanouse, B. B. Studies of two species of *Endogone* in culture 47

Karling, J. S. A new predacious fungus 307

Linder, D. H. & Seaver, F. J. Report on the taxonomic sessions of the International Botanical Congress 92

Lockwood, L. B. Fungi from laboratory reagents 10; *Rhizopus elegans* Eidam 542

Lohwag, Heinrich. An ancient Roman toadstool carved in stone 396
Martin, G. W. *Atractobasidium Grandinia* (Rick) comb. nov. 198; Fungi of South Australia 85; Illustrations of Myxomycetes 296; Some Australian Heterobasidiomycetes 214
McCormack, H. W. The morphology and development of *Caliciopsis pinea* 188
Miller, J. H. & **Wolf, F. A.** A leaf-spot disease of honey locust caused by a new species of *Linospora* 171
Nussle, H. A. The genus *Underwoodia* 236
Plakidas, A. G. & **Edgerton, C. W.** A new imperfect fungus 82
Ray, W. W. Pathogenicity and cultural experiments with *Caliciopsis pinea* 201
Rogers, D. P. *Atractobasidium* 398; Basidial proliferation through clamp-formation in a new *Sebacina* 347
Sass, J. E. Cytology of spore germination in the bispored form of *Psalliota campestris* 431
Seaver, F. J. Photographs and descriptions of cup-fungi—XXII. *Dasyscypha* 1; Mycologia special offer 85; The genera *Phillipsia* and *Cookeina* 90; Photographs and descriptions of cup-fungi—XXIII. *Stamnaria* 186; British stem- and leaf-fungi 199; Photographs and descriptions of cup-fungi—XXIV. *Chlorociboria* 390; Bessey's textbook of mycology 395; The mushroom handbook 395
—— & **Linder, D. H.** Report on the taxonomic sessions of the International Botanical Congress 92
Shear, C. L. Uniformity and stability of mycological nomenclature 337
—— & **Davidson, R. W.** The life histories of *Botryosphaeria melanops* and *Massaria Platani* 476
Smith, A. H. Studies in the genus *Mycena*. III 410
Smith, C. O. *Lepiota Morgani* in southern California 86
Snell, W. H. Notes on Boletes. IV 13; Key to the Boletaceae 198; Notes on Boletes. V 463
Snyder, L. C. New and unusual discomycetes of western Washington 483
Sparrow, F. K., Jr. Chytridiaceous fungi from two unusual substrata 87; Evidences for the possible occurrence of sexuality in *Diplophlyctis* 321
Sprague, Roderick & **Johnson, A. G.** A new *Pseudodiscosia* 181
Stevens, N. E. Two species of *Physalospora* in England 330; A note on the temperature relations of certain fungi 510
Stevenson, J. A. More pavement breakers 87
Stewart, F. C. The persistence of *Hypholoma incertum* about tree stumps 445
Swartz, Delbert. The development of *Lycoperdon acuminatum* 278
Tai, F. L. Sex-reaction linkage in *Neurospora* 24
Taubenhaus, J. J. & **Christenson, L. D.** Insects as possible distributors of *Phymatotrichum* root rot 7
Thompson, G. E. *Nyctalis parasitica* and *N. asterophora* in culture 222
Tiffney, W. N. & **Blank, I. H.** The use of ultra-violet irradiated culture media for securing bacteria-free cultures of *Saprolegnia* 324
Wehmeyer, L. E. Cultural studies of three new Pyrenomycetes 35; Cultural life histories of *Melanconis* and *Pseudovalsa*. II 528
Whetzel, H. H. & **Buchwald, N. F.** North American species of *Sclerotinia* and related genera. III. *Ciboria acerina* 514
White, W. L. A new species of *Chondropodium* on *Pseudotsuga taxifolia* 433
Wolf, F. A. A correction 85; False mildew of red mulberry 268
—— & **Miller, J. H.** A leaf-spot disease of honey locust caused by a new species of *Linospora* 171
Woodworth, R. H. Sporangia of a Phycomycete in vessels of *Philodendron rigidifolium* 77

INDEX TO GENERA AND SPECIES[1]

New names and the final members of new combinations are in **bold face type.** Mistakes in the spelling of scientific names encountered in text are corrected in the index.

Absidia 543, 544
Acaulopage 371; ceratospora 370, 372; **cercospora 371, 372,** 373, 378, 388; macrospora 372, 374, 376
Achlya 328; polyandra 329
Acrospermum 228, 232–235; compressum 228–231; graminum 231
Acrotelium 112
Actinomucor 542, 545; repens 542, 546
Actinomyces 364
Agaricum squamosum 154, 159, 166
Agaricus 87, 93, 350, 406; aureus 159; squamosus glaber 165; villosus 155
Allomyces 443; arbuscula 439, 441, 443
Amanita 63, 64; Caesarea 64, 65, 67, 397; calyptrata 64, 66, 76; calyptratoides 66; calyptroderma 64, 66, 76; chlorinosma 65, 69, 72, 73; cothurnata 65, 70, 73, 75, 76; formosa 67; junquillea 65, 69, 70; Mappa 65, 74, 75; muscaria 64, 67, 68, 70; muscaria formosa 67; pantherina 65, 68, 70, 74–76; pantherinoides 74; phalloides 64, 66, 67, 74; porphyria 74; praegemmata 65, 70; rubescens 70; silvicola 65, 73; solitaria 65, 71, 72; strobiliformis 72; tomentella 65, 73, 74; umbrina 68; umbrinidisca 64, 66; verna 64, 67; virosa 64, 67
Amaurascus 498, 616
Amaurochaete 560; fuliginosa 557
Amphisphaeria 341
Anematidium oxiphilum 10
Angiopsora 111
Arachniotus 497, 498, 501; aureus 497; candidus 497; citrinus 498; ruber 497; trachyspermus 498, 502; **trisporus** 499, **500**
Arachnopeziza 248; **Arctostaphyli 247,** 250, 252
Arcyria 560, 563, 564, 567, 592, 594; carnea 557, 561; cinerea 557, 561, 564–566; cinerea digitata 561, 564, 569; denudata 557, 562–564; ferruginea 557, 561, 562, 564, 566, 567; Gabriellae 563; incarnata 557, 560, 563; incarnata fulgens 563; insignis 557, 561, 564; insignis dispersa 564; insignis major 564; magna 557, 564, 565; nutans 557, 564–566; occidentalis 557, 566, 567, 594; Oerstedtii 557, 565, 566; pomiformis 557, 561, 564, 566; stipata 557, 566
Armillaria 222
Arthrobotrys 241; oligospora 241
Ascobolus carbonarius 483; magnificus 403; viridulus 483
Ascocalyx 451, 453, 460, 461; Abietis 451–454, 456–461
Ascocorticium 356, 358
Ascodesmis 152, 403
Ascomyces Quercus 31
Ascophanus Aurora 153
Ascoxyta Quercus 477
Aspergillus 11, 403; fumigatus 11; herbariorum 135, 153; niger 11; Phoenicis 11, Sydowi 11; Tamarii 11
Asterophlyctis sarcoptoides 88
Asterophora 83
Atractobasidium 398; corticioides 198, 398; **Grandinia 198,** 398
Auricula flammea 155, 159

Bacillus subtilis 326, 329
Badhamia 557, 567, 568, 577, 601; affinis 567, 568; decipiens 557, 567; foliicola 557, 567, 568, 570; gracilis 557, 568; lilacina 557, 568; macrocarpa 568; magna 557, 569, 570; orbiculata 557, 569; panicea 557, 568, 569; papaveracea 557, 568, 570; rubiginosa 557, 570; utricularis 557, 568, 570
Baeomyces roseus 101
Bdellospora helicoides 368
Belonium 304; **aggregatum 303; inconspicuum** 303, **304; Parksi 248,** 250, 252; pulvinatum 247
Boletinus 15, 16, 468; castanellus 468; paluster 15, 400; pictus 16, 102; squarrosoides 468
Boletus 102, 154; acanthoides 155; affinis 18, 19; albellus 493; albidus eupachypus 464; alutarius 17, 18; Ananas 475; Atkinsoni 463; auripes 19; badiceps 18, 19, 20; bicolor 17; calopus 464; carolinensis 13; castaneus **purpurinus 465**; caudicinus 155, 159; cellulosus 159; **chrysenteroides 468,** 470; chrysenteron 21, 102, 469, 471; Clintonianus 400; crassipes 18, 19, 20; Curtisii 13, 17; decorus 22, 23; dissimilis 464; eccentricus 18, 19, 20; edulis

[1] This index was prepared by Miss Bernice Seaver.

pinicola 464; elbensis 400; elegans 155; felleus 17, 18, 465; felleus **albiceps 466**; felleus **plumbeoviolaceus 465**; felleus **rubrobrunneus 466**; fistulosus 13; frustulosus 471; fulvus 18; fumosipes 102, 469, 470, 475; Gertrudiae 17; glabellus 472; granulatus 14; hemichrysus 463; holopus 493; impolitus 14, 15, 463; indecisus 17, 18; isabellinus 475; Juglandis 155, 159, 164; leucophaeus 13, 14; miniatoolivaceus 17; mirabilis 463, 464; niveus 471, 493; obsonium 14; olivaceus 464; pachypus 464; **peralbidus 471**; piperatus 18; placidus 14; platyporus 159; **plumbeotinctus 472**; polymorphus 163, 164; porphyrosporus 475; **pseudodecorus 22**; rangiferinus 163, 165; rhodoxanthus 465; **rubescentipes 473**; scaber 14; **scabroides 472**; sordidus 475; spectabilis 400; sphaerosporus 400; squamosus 154, 155, 159, 166; subalbellus 463, 471, 475; **subclavatosporus 474**; **subdecorus 21–23**; **turbinatus 20**; variipes 463; vaporarius 165

Bombardia lunata 403

Bothrodiscus 453, 460; pinicola 451, 453, 454, 456, 457, 460, 461

Botryosphaeria 330, 477, 478, 511, 513; advena 477, 479; melanops 476–480, 482, 511–513; Ribis 511, 513

Botrytis Rileyi 397

Bourdotia 217; megaspora 214

Brefeldia 570; maxima 553, 557, 570

Bresadolia caucasica 160; paradoxa 160

Brunchorstia destruens 459–461

Bubakia 106, 107, 111, 114, 117, 119, 127, 130

Bullaria 119, 120, 124–126

Byssochlamys nivea 10, 12

Caliciopsis 188, 195, 202, 204, 234, 433; pinea 188–190, 192, 193, 196, 201–203, 205, 207

Calicium 188, 195

Calloria 251

Calosporella 528

Calvatia craniiformis 278, 283

Camarosporium **Ceanothi 211**

Cantharellus 222, 225; floccosus 102

Cenangella 299; Fraxini 299; **oricostata 298**, 299, 303

Cenangium 452; Abietis 459; pithyum 451–453, 456; Ribis 460; **strobilinum 393**; Urceolus 460, 461

Cephalothecium 241

Ceratiomyxa 571; fruticulosa 557, 571; fruticulosa arbuscula 571; fruticulosa dentata 571; fruticulosa descendens 571; fruticulosa filiformis 571; fruticulosa flexuosa 571; fruticulosa porioides 571; porioides 571

Ceratostoma brevirostre 137

Ceratostomella 134, 135, 139, 146, 148, 149, 152, 153; ampullasca 175; fimbriata 133, 142, 145–149, 152, 153; moniliformis 142, 145–148; multiannulata 133, 134, 136, 139, 141, 143, 145, 147, 148, 150, 151

Cercospora Rubi 85

Cercosporella 270–272; arachnoidea 269, 272, 274–276; maculans 272; Mori 272; Persica 270, 277

Cerioporus squamosus 160

Cerotelium 129

Ceuthocarpon 176; populinum 176

Cienkowskia 572; reticulata 557, 572

Charonectria 252; Sambuci 252; Umbelliferarum 252

Chlorociboria 390; **aeruginosa 391**; **strobilina** 392, **393**, 394; **versiformis** 392, **393**, 394

Chlorophyllum Molybdites 86

Chlorosplenium 390; aeruginescens 391; aeruginosum 390, 391; lividum 393; Schweinitzii 390; versiforme 390, 393; versiforme nigrescente-olivacea 393

Chondropodium 434–436; **Pseudotsugae 434, 436**, 437

Chrysomyxa 105–107, 114; Piperiana 105

Chytridium Polysiphoniae 88

Ciboria 390, 391, 514, 522, 524; **acerina** 515, **516**, 517, 519–522, 524, 525, 527; strobilina Bresadolae 394

Citromyces 10

Cladosporium 492

Clasterosporium degenerans 277

Clastoderma 572; Debaryanum 101, 572

Clavaria 164; amethystina 102; Hypoxylon 163, 164

Clitocybe 222

Cochlonema verrucosum 364

Coleosporium 105, 107, 112, 114

Collybia 428; dryophila 102; floccipes 428

Comatricha 572, 573, 576, 589, 620; Ellisii 574; elegans 557, 573; extendens 557, 573, 575; fimbriata 622; flaccida 617; irregularis 557, 573, 575; laxa 557, 574, 575; longa 557, 573, 574; lurida 557, 574; nigra 557, 573, 574, 575, 576; nigra alta 575; pulchella 557, 573, 575, 576; pulchella fusca 575; pulchella gracilis 575, 576; Rispaudii 101, 557,

575; rubens 557, 574, 576; subcaespitosa 557, 575–577; typhoides 557, 576, 577, 614
Cookeina 90, 92; tetraspora 92
Coprinus 87; comatus 87; micaceus 448, 449
Cordyceps 341; ophioglossoides 102
Corniculariella 435; Abietis 435
Cornularia 435, 436; **harpographoides 212**; **Populi 212**; spina 435; Urceolus 435; Viburni 435
Corticium coronilla 350; varians 350
Cortinarius bolaris 102; lilacinus 102
Coryne versiformis 393
Corynesphaera 341
Coryneum 528
Craterellus 225
Craterium 570, 577; aureum 557, 577; concinnum 557, 577; cylindricum 557, 578; leucocephalum 557, 578; leucocephalum scyphoides 578; Maydis 607; minutum 557, 577, 578
Creonectria purpurea 252
Cribraria 578, 596, 621; argillacea 558, 579, 596; dictydioides 558, 579–581; intricata 558, 579–581; laxa 558, 579, 580; macrocarpa 558, 580; microcarpa 558, 580, 581; microcarpa concinna 581; minutissima 558, 579, 580; piriformis 558, 580, 581; tenella 558, 579–581; vulgaris 558, 581; vulgaris aurantiaca 580, 581
Cronartium 106, 107, 112, 114, 127, 129, 130; ribicola 131
Crossopsora 111, 127, 129, 130
Crumenula 459–461; abietina 459–461; pinicola 459–461; sororia 459
Cryptodiaporthe 537, 538, 541; densissima 537; galericulata 537; myinda 537
Ctenomyces 498
Cumminsiella 107, 108, 112, 114
Cunninghamella 544
Curreya **Corni 209**
Cylindrosporium acerinum 102

Dactylaria 241
Dactylella 241
Daldinia 341
Dasyscypha 1, 305; albolutea 305; crucifera 1, 5, 6; Fairmani 305; nivea 1; virginea 1
Dendrosporium 84; **lobatum 84**
Dermatea 304, 459
Dermatella 299
Diachea 581; leucopodia 558, 581
Diaporthe 42, 46, 175, 541; Fagi longispora 42; oncostoma 42; strumella 42, 43, 45, 46; strumella **longispora** 42, 45, **46**
Dicheirinia 107, 112, 114, 119, 127, 130
Dictydiaethalium 582; plumbeum 558, 582; plumbeum cinnabarinum 582
Dictyophora duplicata 401
Diorchidium 127, 130
Dictydium 582; cancellatum 558, 582; cancellatum fuscum 582; cancellatum purpureum 582
Diderma 582, 586, 587; effusum 558, 583, 584, 586, 587; effusum hyalinum 583; effusum reticulatum 583; floriforme 558, 584, 585; hemisphaericum 558, 584; montanum 558, 584, 585; radiatum 558, 584, 585; radiatum umbilicatum 584, 585; simplex 558, 585; simplex echinulatum 585; spumarioides 558, 584, 585; testaceum 558, 584, 586
Didymium 586, 587, 597; affine 589; anellus 558, 586, 588; Clavus 558, 586; difforme 558, 587; eximium 558, 587, 589; nigripes 558, 586–589; melanospermum 586, 587; minus 558, 587, 588; ochroideum 558, 588; squamulosum 558, 588, 589; xanthopus 558, 586, 588, 589, 607
Diplodia 334, 510, 511; Alni 336; Alni-rubrae 335, 336; Coryli 336; Crataegi 335, 336; Euonymi 336; Humuli 336; inquinans 336; macrospora 511–513; macrostroma 335; malorum 336; mamillana 334; mamillana sarmentorum 334; megalospora 511–513; mutila 330–333, 335; natalensis 511–513; Rosae 335; salicina 335; sarmentorum 333–335, 511–513; Siliquastri 335; Tiliae 336; vulgaris 335; Zeae 511–513
Diplophlyctis 321; intestina 307, 321, 322
Discosporium 532; pallidum 532
Dothidea 339–342, 344; Berberidis 340, 341; collecta 176; conspersa 339; melanops 479; melanops pycnidifera 478; moriformis 341; ribesia 340, 341; Sambuci 340, 341; Sambuci Hederae 340
Dothidella 341
Dothiorella 477, 479; advena 478, 479

Echinostelium minutum 622
Ectrogella perforans 88
Elsinoe 489, 491; **australis** 490, **491**; Fawcetti 491, 492; Fawcetti viscosa 491
Elvela aeruginosa 391
Empusa 245
Endocochlus 364; asteroides 364, 366–

368, 370; **brachysporus** 364, 365, **367,** 368, 370, 378, 388; **gigas** 364, 366, 369, **371,** 378, 388
Endogone 47, 48, 53, 57, 60, 61, 62; fasciculata 59; macrocarpa 101; malleola 48, 59, 60, 62; **occidentalis 47,** 54, 55, 57, 59, 61; pisiformis 48, 62; reniformis 48, 59; sphagnophila 47, 48, 50, 53–55, 57, 59, 60, 61, 62
Endomyces 11
Endothia 35, 38; parasitica 46; **viridistroma** 35, 37, **38,** 44
Enerthenema 589; Berkeleyanum 558, 589; papillatum 558, 590
Enteridium 590, 611, 621; olivaceum 558, 590; Rozeanum 558, 591, 611; simulans 591
Entoloma cuspidatum 102; luteum 102; salmoneum 102
Eocronartium muscicola 102
Erinella 248; borealis 248; byssacea 248
Euryachora **Neowashingtoniae 210**
Eutypella 35, 41; **virescens** 39, 40, **41,** 45
Exidia 217, 361; glandulosa 214; nucleata 214
Exoascus 297

Favolus 163
Fomes applanatus 448; geotropus 293, 295
Fuligo 591; cinerea 591, 592; cinerea ecorticata 591; septica 592, 597; septica candida 591, 592, 597; septica rufa 592
Fusarium 403; discolor sulphureum 443; moniliforme 404; orthoceras 11
Fusicoccum 528; Testudo 479
Fusisporium Berenice 451, 452, 456

Gelasinospora 290; tetrasperma 284, 288, 290, 404, 406, 409
Gelatinosporium 435; Pinastri 435
Glaziella 61
Gloeoglossum affine 102
Gloeosporium 173, 177, 179
Gloeotulasnella traumatica 350
Glomerella cingulata 404; Lycopersici 404
Glomerula repens 542
Godronia 299, 435, 436, 460; Urceolus 305
Godroniopsis quernea 299
Gorgoniceps 101
Guepinia Peziza 221
Guepiniopsis Peziza 221
Guignardia Bidwellii 191
Gymnoascus 497, 498
Gymnosporangium Haraeanum 113; Juniperi-virginianae 113; Yamadae 113, 131
Gyrodon 467

Hainesia Lythri 102
Hapalophragmium 119, 127, 130
Harpella Melusinae 246
Helminthosporium 403
Helotium 251, 390; aeruginosum 391; aureolum 251; **cremeum 249,** 250, 252; Humuli 251; **nitens** 250, **251,** 252; separabile 251; subtrabinellum 251; sulphuratum Piceae 303; versiforme 393
Helvella 486; crispa 483; lacunosa 483; pallescens 89, 90; palustris 89, 90; Queletii 90
Hemiarcyria longifila 593
Hemitrichia 560, 567, 592, 597, 598, 617; clavata 558, 593, 594; intorta 558, 593; leiocarpa 597; serpula 558, 593; stipitata 558, 593; vesparium 558, 593, 594, 619
Hendersonia 481; Desmazieri 481; Platani 482
Hercospora 528, 529
Heteropatella 182; Dianthi 182, 183; graminis 183
Heterotextus alpinus 221; flavus 219–221
Heterotrichia Gabriellae 563
Humaria 356; granulata 403; rutilans 348, 361
Humarina convexula 483; **macrocystis 484**
Hyalopsora 106, 107, 114, 117, 119
Hydnellum humidum 102; scrobiculatum 102; velutinum 102; zonatum 102
Hydnum fennicum 102; imbricatum 102
Hydropisphaera 341
Hymenobolina parasitica 622
Hypholoma 448, 449; fasciculare 350; incertum 445, 446, 448–450
Hypochnus botryoides 102; fumosus 102
Hypomyces hyalinus 102
Hypoxylon 153; coccineum 136, 149
Hypsotheca 188
Hysteropsis **guajava 210**

Ithyphallus Ravenellii 87

Kleistobolus pusillus 101, 622
Kuehneola 108, 119, 129

Lachnella crucifera 6
Lachnobolus 566, 594; congestus 558, 594
Lachnum 1, 305; calyculaeforme 304,

305; calyculaeforme latebricola 305; fuscofloccosum 305
Lactaria 222, 227, 253; atroviridis 102; aurantiaca 262; chrysorhea 102; Indigo 102; **luculenta 260**, 261; mitissima 262; obnubila 260, 261, 265; rufa 263, 264; rufula 263, 264; vellerea 102
Lactarius (see Lactaria)
Lamproderma 572; arcyrionema 558, 595; columbinum 553, 558, 595; muscorum 101; scintillans 558, 595; violaceum 558, 595
Lamprospora carbonaria 486; **fulgens 484**; **pyrophila 484**, 485
Lentinus lepidus 163
Leocarpus 595; fragilis 559, 595
Lepidoderma 583
Lepiota chlorospora 86; Morgani 86
Leptostroma hypophyllum 171, 177
Licea 596; biforis 101, 559, 596
Lindbladia 596, 621; effusa 559
Linhartia 300
Linospora 172, 176, 177, 180, 341; Capreae 172, 176, 177; **Gleditsiae** 173, **177–180**; populina 176, 177
Lycogala 596; epidendrum 552, 559, 596; exiguum 559, 596; flavofuscum 559, 597
Lycoperdon acuminatum 278, 280, 282; pedicellatum 283; Wrightii 283

Macrophoma Granati 97, 98
Magnusiella 297
Mainsia 108, 112, 119
Maravalia 112, 119, 128, 130; hyalospora 128; utriculata 128
Massaria atroinquinans 481; Platani 480, 481; semitecta 481
Melampsora 106, 107, 111, 112, 114, 127, 130; Lini 106, 111, 131
Melampsorella 106
Melampsoridium 107, 114
Melanconiella 528; larga 532; Meschuttii 529; nigrospora 529
Melanconis 528, 531, 533, 538, 541; Alni 537; apocrypta 533, 535, 537; leucostroma 538; marginalis 537; modonia 528; **Pallida 529**, 530, 532, 533, 535; perniciosa 528; stilbostoma 537; sulphurea 528; thelebola 528, 537; xanthostroma 528
Melanconium 528, 529, 531–533; gracile 532; juglandinum 531; intermedium 530, 532, 535; magnum 532; pallidum 532, 533; populinum 536
Melanops 330, 336; Tulasnei 478, 479
Melanopus squamosus 160
Melanospora Gibelliana 137; globosa 137; Mangini 137; parasitica 137; stysanophora 137; Zabelli 137; Zamiae 137, 152
Melasmia 172, 173; Gleditschiae 171, 179; hypophylla 171, 179
Microascus 508; intermedius 508; **lunasporus 503**, 508; sordidus 508; trigonosporus 508
Micropera 435
Melanospora 135, 137, 139, 149, 151; aspergilliformis 137
Milesia 106, 107, 114
Modicela 48, 60
Mollisia ribesia 301
Monacrosporium 241
Monascus 149
Monilia sitophila 404
Monosporidium repens 241
Mortierella 59
Mucilago 597; spongiosa 559, 597; spongiosa solida 597
Mucor 53, 60, 542–545, 622; botryoides 542, 546; christianiensis 544; circinelloides 544; coprophilus 544; corymbosus 542, 543; cunninghamelloides 542, 543; genevensis 544; geophilus 544; glomerula 542; griceocyanus 544; griceolilacinus 544; hiemalis 544; javanicus 544; plumbeus 544; racemosus 543, 544; repens 542; Romannianus 50, 53; Romannianus angulospora 53; stolonifer 542; zeicola 544
Mycena 410, 418, 428, 430; acicula 414; Adonis 417; alcalina 419, 421; amicta 410, 416–418; atribrunnea 428; atroalboides 424; aurantiidisca 414; aurantiomarginata 410, 412, 419–421; bryophila 413; capillaripes 412, 421; cinerella 412, 422; Cooliana 413, 429; corticola 418; cyaneobasis 418; cyanothrix 418; elegans 416, 420, 421; excisa 423; filipes 423, 424; galopoda 410, 424; iodiolens 424; iris caerulea 418; juncicola 410, 412, 416, 425; Leaiana 420; Meulenhoffiana 413; militaris 426; mirata 429; **nodulosa 411**; **oregonensis** 412, **413**, 414; pterigena 425; quiniaultensis 415; roseipallens 417; scabripes 410, 426–428; **siskiyouensis 414**; strobilinoidea 413; subcaerulea 418, 419; subvulgaris 415; **tenax** 410, **414**–416, 427; tenella 428; trachyspora 410, 412, 429; vulgaris 415, 426
Mycosphaerella 85, 176, 271, 272; **arachnoidea 275–277**; **confusa 85**; dubia 85; Mori 272, 273; moricola 272–275
Mylittopsis Langloisii 350
Myxosporium 528
Myxotrichum 498

Naemosphaera **pinicola 211**
Nectria 341; galligena 135, 152; Heraclei 252; mammoidea 135, 153; Sambuci 252
Nectriella 98, 247; dacrymycella 252; Sambuci 252; Umbelliferarum 252; Versoniana 95, 97
Neopatella **Kauffmani 212**
Neurospora 24, 29, 30, 100, 284, 285, 288, 290, 291, 405, 406; crassa 24, 29, 30; intermedia 29; sitophila 29, 403, 405, 408, 409; tetrasperma 24, 29, 288, 290, 291, 349, 360, 404–409; Toroi 29, 404
Niptera 300
Nomuraea 397; prasina 397
Nyctalis 222; asterophora 222–227; parasitica 222–227

Obelidium mucronatum 88
Oligonema 597, 598, 618; brevifilum 598; flavidum 559, 597, 598; nitens 559, 594, 598
Ombrophila strobilina 394
Omphalia 423; picta 423
Ophiodothella 176, 177, 180
Ophiotheca 599; Wrightii 599
Orcadella operculata 622
Otthia Pyri 330

Papulospora aspergilliformis 137, 152
Patella abundans 486
Patouillardina 398; cinerea 398
Paxillus 16
Paxina 486; **compressa** 485, **486**; **recurva** 485, **487**
Penicillium 12, 403, 499; cupricum 10, 12; glaucum 10, 12; lilacinum 10, 11; luteum 404; purpurogenum 11
Peckiella lateritia 135, 153
Peniophora 217; aurantiaca 350
Perichaena 599; chrysosperma 559, 599, 600; corticalis 559, 596, 599, 600; depressa 559, 600; vermicularis 559, 599, 600
Peridermium himalayense 131
Peripherostoma 341
Petersenia lobata 88
Peziza 2, 4, 452; Abietis strobilina 393; aeruginescens 391; aeruginosa 391; aurantia 2; barbata 3; brunneola 3; bufonia 487; bulgaroides 394; Catinus 348; chlora 390; ciborioides strobilaria 393; clandestina 3; crucifera 2, 3, 4; echinulata 2, 3; epixantha 3; gracilipes 525; gracilipes tetraspora, 524, 525; incondita, 524, 525, 526; latebricola 3; macrocystis 484; marginata 3; palearum 3; papillaris 3; patula 3; pellita 3; pinicola 460; rosea 3; scabrovillosa 3; Schweinizii 3; solfatera 3; Spiraeae 3; tuberosa strobilina 393; versiformis 393; versiformis livida 393; virginea 3, 4
Pezizella aspidiicola 251; **aurantiaca 301**, 303; chrysostigma 251; versicolor 251
Phaeotremella 214
Phakopsora 107, 111, 114
Phallus impudicus 401
Phellodon alboniger 102; velereus 102
Phialophora 288
Phillipsia 90; domingensis 92; gigantea 92
Phleogena 350
Phoma 96, 341; **Anemones 210**; Granati 98; regina 211; Versoniana 97, 98
Phomopsis Versoniana 97
Phragmidium 107, 112, 114, 116
Phragmopyxis 107, 116
Phycomyces 402
Phylloporus 16
Phyllostictina carpogena 191
Phymatotrichum 7, 8, 9; omnivorum 7, 8, 9
Physalospora 330, 331, 332, 477, 478, 511; Cydoniae 333; glandicola 332, 511–513; **mutila 333**, 511, 513; obtusa 330, 333, 511–513; rhodina 332
Physarella 601; oblonga 601, 603, 607
Physarum 601, 605, 607; aureum 609; bogoriense 559, 601; cinereum 559, 601, 602, 609; cinereum nitens 609; citrinum 559, 602; compressum 559, 602, 605; confertum 559, 602; connatum 567, 604–606; didermoides 559, 602; didermoides lividum 602; flavicomum 559, 602; galbeum 559, 603; globuliferum 559, 603, 604–607; gyrosum 559, 601, 603; lateritium 559, 603, 609; leucophaeum 567, 604; leucopus 101, 605; Maydis 607; melleum 559, 604; murinum 559, 603, 604; notabile 559, 567, 602–604, 606; nucleatum 559, 606, 608; nutans 559, 604–606, 610, 611; nutans leucophaeum 605; nutans robustum 605; oblatum 559, 606, 608; penetrale 101, 552, 559, 607; polycephalum 559, 601, 607; polycephalum obrusseum 607; pulcherrimum 559, 607; pusillum 559, 606, 607; rubiginosum 559, 608; sessile 608, 609; sinuosum 559, 608; sulphureum 608, 609; tenerum 559, 602, 608; variabile 559, 608, 609; vernum 601, 602; virescens 559, 602, 604, 609; viride 559, 609–611; viride aurantium 609; viride Beth-

elii 609; viride incanum 606, 609, 610
Physospora 83
Phytophthora 328, 329; infestans 376
Pilacre Petersii 350
Pileolaria 107, 108, 112, 114, 119, 128, 130, 131; phyllodiorum 128
Pithya vulgaris 488
Platygloea 198; Grandinia 198, 398
Plectania 90
Pleospora 403
Pleotrachelus Andréei 88; sphacellarum 88; tumaefaciens 88
Pleurage 284; anserina 285–291; 404, 406, 409; taenioides 285, 286, 404, 409
Plowrightia 340; morbosa 176
Pluteus coccineus 493; leoninus 493
Podospora anserina 285, 291; curvula 285
Polyporoletus 467; **sublividus 467**
Polyporus 156, 165, 169; arcularius 168; Berkeleyi 102; caudicinus 155, 160; fagicola 157, 166–168; fagicola glaber 168; flabelliformis 159; flammeus 155; flavovirens 102; giganteus 155; infundibuliformis 165; Montagnei 102; pallidus 165, 166, 168; pennsylvanicus 165, 167–168; Rostkowii 165, 166, 168; sessilis 155, 159; squamosus 154–168; squamosus aureus 161, 166; squamosus erecta 161; squamosus **fagicola 166**; squamosus glaber 165; squamosus **polymorphus 163**; tigrinus 159; Ulmi 159; vaporarius 165
Polystigma rubrum 135, 152
Pontisma lagenidioides 88
Poria eupora 102; vaporaria 165
Propolis Betulae 298; faginea 298; faginea **atra 297** [bis]
Prospodium 107, 108, 112, 114, 119
Psalliota campestris 431, 432
Psathyrella disseminata 449
Pseudodiscosia 182, 183; **Avenae** 182, **183**, 184; Dianthi 182
Pseudographium 434; Persicae 434
Pseudohelotium laricinum 303
Pseudoplectania fulgens 484
Pseudovalsa 528, 529, 538, 541; aucta 541; macrosperma 541; stylospora 537, 538, 540, 541
Psorotheciopsis 300
Puccinia 107–112, 114–126, 128–130, 406; anomala 123, 128; Balsamorrhizae 110; Bistortae 124; Blasdalii 112, 123; Cockerelliana 128; cognata 110; conspicua 112, 128; coronata 112, 123, 128; Cyani 110; Eatoniae 112, 123, 128; evadens 112; glumarum 112, 123, 128; graminis Tritici 113, 131, 132; granulispora 123; Helianthi 124; Hordei 123, 128; karelica 129; Koeleriae 123, 128; Liatridis 112, 123, 128; montanensis 128; nuda 110; orbicula 124, 125; Oxalidis 112; paradoxica 124; phyllodiorum 128; Piperi 128; Plucheae 110, 111; Poae-sudeticae 112, 128; Poarum 128; Porri 123; procera 128; pygmaea 128; recedens 102; rubigovera 112, 128; sessilis 128; subangulata 123; subdecora 110; tenuis 102; turgidipes 110; vexans 113
Pucciniastrum 106, 107, 114; Myrtilli 102
Pycnocalyx Abietis 453, 454, 456
Pyrenopeziza rimicola 301
Pyronema 133, 137, 148, 347–349, 355, 356, 358, 403; confluens 153, 355, 360, 361

Ravenelia 107–109, 112, 114, 115, 118, 127, 130, 132; Cassiae-Covesii 109; Hoffmanseggiae 109
Reticularia 611; Lycoperdon 559, 591, 611
Rhabdospora **Arctii 211**
Rhizidium mycophilum 88
Rhizoclosmatium globosum 88
Rhizophidium discinctum 88; globosum 88
Rhizopus 542–545; arrhizus 543; Artocarpi 543, 544; bovinus 544; chinensis 544; Cohnii 544; delemar 544; elegans 542–545; formosaensis 544; fusiformis 543, 544; liquefaciens 543; microsporus 543; nigricans 542–545; nigricans verticillatus 543; nodosus 544; Oryzae 544; Peka 544; pusillus 544; pygmaeus 543, 544; reflexoides 544; reflexus 543, 544; shanghaiensis 544; suinus 544; Tritici 544; umbellatus 543
Rhytisma acerinum 175, 180
Russula 222, 227, 253; amoena 267; astringens 259; atroviolacea 254, 258; badia 259; brunneola 265; **californiensis 262**, 263, 266; corinthiirubra 254; foetens 222, 227; gracilis 255; **inconstans 255**, 256; integra 257; maculata 256; **marginata 257**, 259; Mariae 253, 264, 267; **mordax 258**, 259, 267; murina 254; nigricans 227; **placita 253**, 254, 256; puellaris 257; punctata 267; Romellii 264; sanguinea 265; tenuiceps 259; vesca 265; **Zellerii 256**
Rutstroemia bulgaroides 394

Sacidium Gleditschiae 171, 177
Saprolegnia 324, 325, 327–329

Sarcoscypha 90
Schizoparme 97; straminea 95, 97
Scleroderma Geaster 87
Scleroderris 460, 461; **lobata 248**, 250, 252; pitya 465; ribesia 249; Ribis 461; tumoricola 249
Sclerotinia 297 [bis], 305; Gladioli 403, 524, 526; incondita, 526
Scopulariopsis 503, 508; **lunaspora 504**, 508
Sebacina 217, 351, 352, 357, 361; calospora 351; fugacissima 351; globospora 361; incrustans 102; megaspora 214, 215, 221; **prolifera 350–352**, 356–360, 362; Pululahuana 217
Secotium agaricoides 283
Seismosarca 217, 218; alba 217; hydrophora 217, 218, 220, 221
Septogloeum **parasiticum 213**
Siphonaria 323; variabilis 88
Sirobasidium 218; Brefeldianum 218; Cerasi 218; magnum 218; sangiuneum 218, 220, 221
Sirolpidium Bryopsidis 88
Sommerstorffia 309; spinosa 307, 311, 313, 320
Spathularia velutipes 101
Sphaceloma 491, 492; australis 491; Fawcetti viscosa 489, 491, 492
Sphaerella 272; dubia 85; Mori-albae 272, 273; morifolia 272, 273, 275
Sphaeria moricola 275; Pupula 481; quercina 479; sarmentorum 334, 335
Sphaerophragmium 119, 127, 130, 434
Sphaerographium hystricinum 435
Sphaeropsis 341, 531; **cornicola 211**; depressa 335; Mali 331, 332; malorum 330–332, 511; pseudodiplodia 333
Sphaerospora brunnea 101
Spicaria 397, 398; prasina 397; **Rileyi 398**
Sporodinia 403
Sporotrichum 11
Stamnaria 186; Equiseti 186; **Thujae 186**, 187
Steganosporium Platani 482
Steironema ciliatum 102
Stemonitis 572, 576, 611, 613, 620, 621; axifera 559, 611, 612, 615; carolinensis 559, 612; confluens 559, 612; fenestrata 559, 612; flavogenita 559, 613; fusca 559, 611, 613, 615, 616; fusca flaccida 614; fusca rufescens 613; herbatica 559, 613–615; hyperopta 559, 613, 614; pallida 559, 612–615; Smithii 559, 613–615; splendens 559, 611, 612, 615–617; splendens flaccida 617; trechispora 559, 615, 616; virginiensis 559, 613, 616; Webberi 559, 616, 617
Stephanoma strigosum 102
Stilbospora 528; quadriseptata 481
Stylopage 374; araea 244; hadra 241–245, 376; **leiohypha 243, 244**, 246; lepte 376; **rhabdospora 374**, 375, **377**, 388
Syncephalastrum 544
Syphosphaera 341
Systremma 341

Tapesia 300, 301; coloradensis 301; **Lonicerae 299**, 303; melaleucoides 301; **ribicola 300**, 301, 303
Taphrina 31, 32, 33, 297; castanicola 32; **Castanopsidis 32, 33**; coerulescens 32, 297; Quercus 32
Texiffigia Corni 101
Thecotheus Pelletieri 153
Tranzschelia 107, 108, 112, 114
Trematosphaeria **cornina 209**
Tremella 361; frondosa 214; mycetophila 102
Tremellodendron pallidum 102
Trichia 553, 592, 597, 598, 617, 618; affinis 560, 617, 619, 620; alpina 560, 618; Botrytis 560, 618; Botrytis flavicoma 618; contorta 560, 618; decipiens 560, 618; decipiens olivacea 618; favoginea 560, 617, 618, 619; floriformis 560, 619; inconspicua 560, 619; persimilis 560, 594, 617, 618, 619, 620; pulchella 560, 617, 620; scabra 560, 620; varia 560, 617, 620
Trichobelonium 303
Tricholoma 428
Trichothecium 241
Tubifera 596, 620, 621; Casparyi 560, 620, 621; ferruginosa 560, 596, 621; stipitata 560, 621
Tulasnella 348, 361; rutilans 350
Tympanis 459; conspersa 339

Underwoodia columnaris 236, 237, 240
Uredinopsis 106, 107, 114
Uromyces 108, 112, 114, 116–120, 122–124, 126, 128–130; occidentalis 124; punctatus 124
Uromycladium 119, 127, 128, 130
Uropyxis 107, 112, 114, 116, 119

Valsa 35, 341
Venenarius praegemmatus 70; umbrinidiscus 66

Volvaria gloiocephala 396; speciosa 396

Xylaria polymorpha 136; tentacularia 136, 149

Zoopage 378, 381, 384; **atractospora** 378, 379, **381**, 383, 386, 389; **cladosperma** 364, 384–**386**, 389; **nematospora** 364, 381, **383**; phanera 376, 378, 380, 381, 384, 386
Zoophagus 318; insidians 307–313, 315, 316, 318–320, **tentaculum 308**, 309, 312, 313, 315, 316, 319
Zygorhynchus 403
Zythia 96, 97; Versoniana 95